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CONTENTS

Collective Coercion and Shot-Gun Bargaining. *By Louis Ruthenburg* 15
With Collective Bargaining Established Union's Next Step Is Management Control. *By Leonard Westrate* 17
Utilization of Atomic Energy. *By Dr. Clark Goodman* 18
Experimental Verification of Cumulative Fatigue Damage. *By Milton A. Miner* .. 20
New Applications of Glue in the Automotive Field. *By H. B. Sweatt* 25
Schwitzer-Cummins Plant Organized for Small Lot and Mass Production of Engine Equipment. *By Joseph Geschelin* 26
Tooling Possibilities of Plaster of Paris. *By John Delmonte* 32
Injection of Anti-Detonating Fluids in Aircraft Engines 34
Truck Registration Gains 114,000. *By Marcus Ainsworth* 40
Aircraft Engine Progress. *By Col. Donald J. Kiern* 42
New Production Equipment 44
New Products for Aircraft 46
New Products 48
News of the Industry 51
Calendar of Coming Events 54

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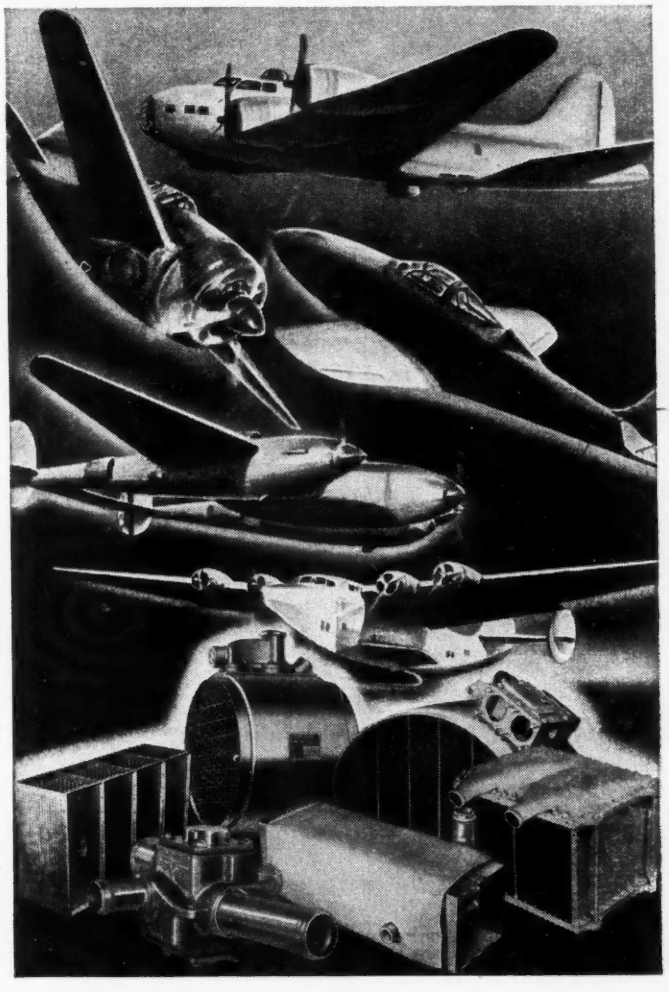

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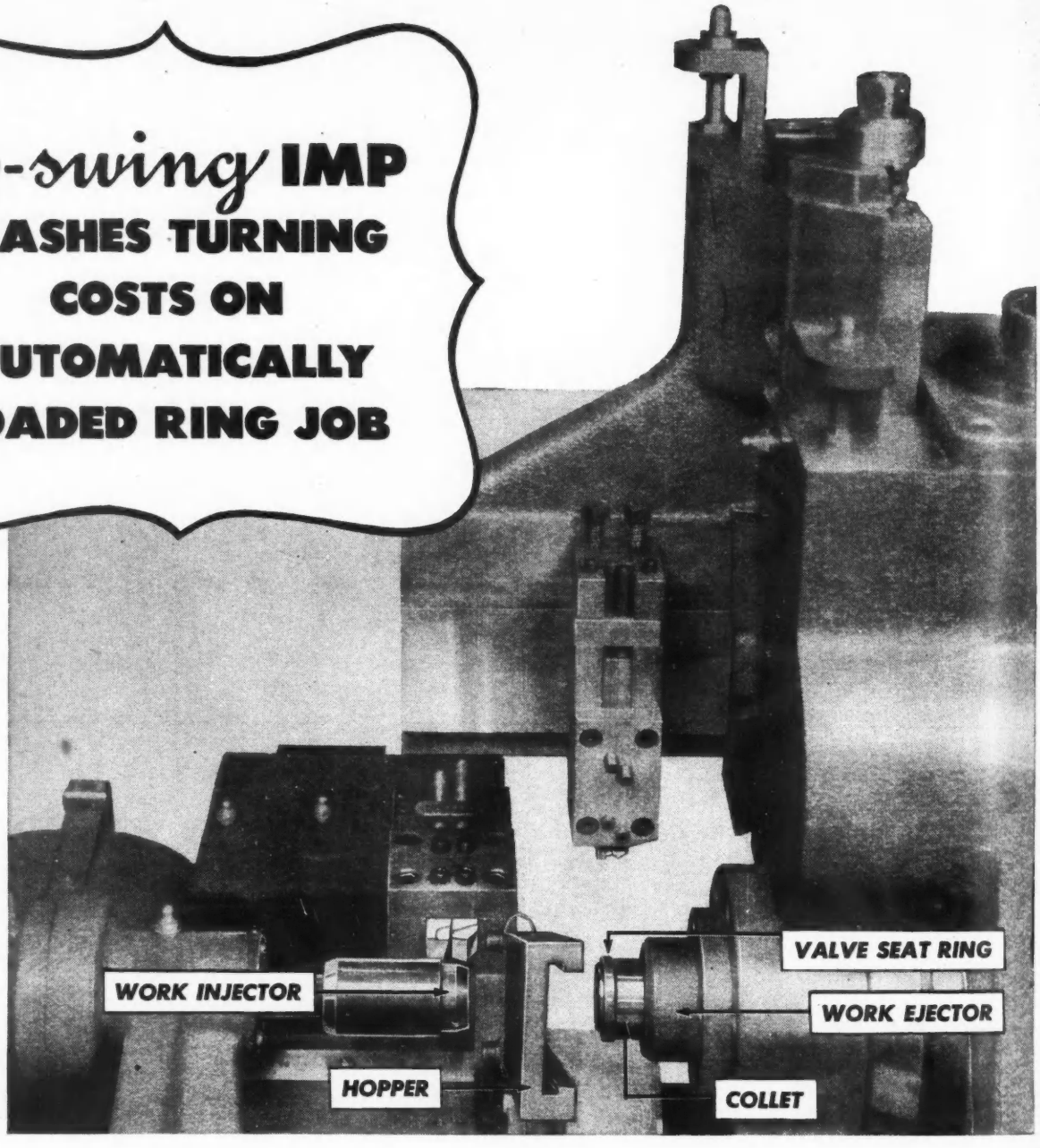
Lo-swing IMP SLASHES TURNING COSTS ON AUTOMATICALLY LOADED RING JOB



Problem: **To automatically load and unload, rough turn, finish turn and chamfer the outside diameter of Valve Seat Rings.**

Solution: **The IMP Automatic Lo-swing Lathe selected for this job was equipped with the Seneca Falls Ram Type Loader used successfully on many types of small parts with a substantial reduction in manufacturing costs.**

Rings are loaded in the hopper (shown in above illustration) and are automatically picked up and placed on the air operated collet by the work injector.

Two carbide tools on the front carriage rough and finish turn the outside diameter while one edge is rounded and the other chamfered by two tools set on the vertical slide. All tools then withdraw, pressure on the collet is released, and the work ejector thrusts the finished piece into the unloading chute.

The entire cycle is automatic; the spindle revolves continually—even during loading and unloading—thereby reducing starting and stopping fatigue on the motor, pulley, belts and other drive mechanisms.

A similar tool layout is used for the boring operation on these rings; the only difference is that the piece is held on its outside diameter instead of from the inside.

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the first and 15th of the month

December 1, 1945
Volume 93, No. 11

Collective Coercion and Shot-Gun Bargaining

By Louis Ruthenburg

THE most superficial observer of the current scene must be conscious of an impending crisis. Reconversion is all but stalled as the result of strikes affecting or about to affect our basic industries and their infinite ramifications. All manner of legislative measures which would radically influence the country's future economic and social relationships impend.

We are deeply disturbed by a growing sense of futility and frustration—an increasing consciousness that something must be basically wrong at the very roots of our national structure. Why are millions of job opportunities being destroyed even as the universal cry for full employment persists? Why do we have the strange anomaly of increasing unemployment and simultaneous labor shortages? Why this double talk about astronomical wage increases with prices held unchanged? Why can no stable basis of agreement be reached? Why can no effective remedial legislation be drafted? Why? Why? Why?

The answer is very simple indeed. We, the people of the United States, are re-enacting the legend of the Tower of Babel because the very foundation upon which this republic was erected is being destroyed! A startling and intemperate statement? I think not. Let's face the facts. The basic precept upon which our United States was founded is this: ALL MEN STAND EQUAL BEFORE THE LAW. Again and again during recent years that fundamental principle has suffered violence, and a potent minority finds preference before the law.

First as the result of a strange mixture of idealism and political expediency and more recently through the exertion of powerful political pressures, organized labor, which, according to its own most optimistic estimates, includes less than 10 per cent of our population and not more than 25 per cent of those gainfully employed in this country, has been given special privileges under the law. Such privileges have been awarded to organized labor at great potential cost to the American public. Among the most immediate victims of organized labor's preferential position are the returning veterans—equal in number but very unequal in status under the law.

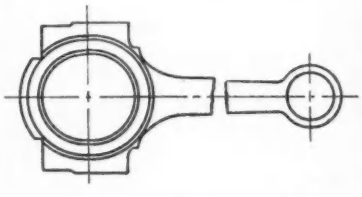
Wholly consistent with the spirit of the Wagner Act and other statutes, the courts of the United States have granted to organized labor what Donald Richberg has described as "immunity from various provisions of the law affecting monopoly, intimidation, extortion and riotous assembly."

Through such measures, which could be catalogued almost endlessly, has the road to oppression and anarchy been opened. After such violation of the funda-

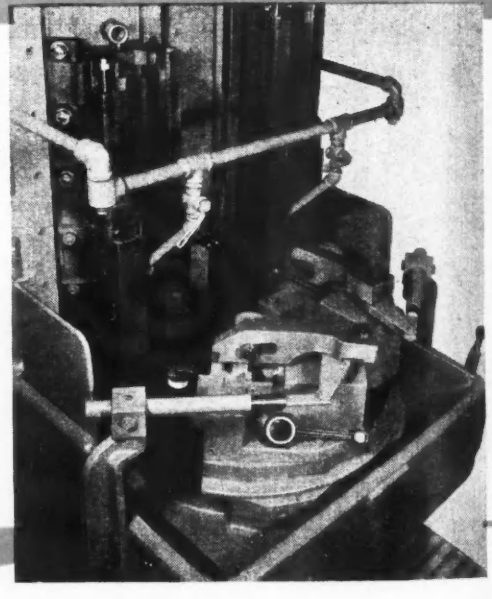
(*Turn to page* 105, *please*)

Each stroke of the Ram

BROACHES ALL THESE SURFACES OF A CONNECTING ROD AND CAP FORGING



Part name: Connecting rod
Material: Steel forging
Operation: Broach locating pads and nut and bolt seats
Production: 434 per hour
Machine: CINCINNATI No.5-42 Duplex Hydro-Broach
Tooling: By Cincinnati Application Engineers



Employing the "wrap around"* principle, CINCINNATI Application Engineers devised an insert arrangement to broach the locating pad and nut and bolt seats of both bolt bosses on connecting rod and cap forgings. Complete equipment includes a CINCINNATI No. 5-42 Duplex Vertical Hydro-Broach, with automatic clamp and release fixtures, broach holders and broaching tools. ¶ The production rate of 434 parts per hour is evidence of the low unit cost achieved on this job. ¶ Why not submit your surface broaching jobs to Cincinnati Application Engineers? They will be glad to give you the benefit of many years' experience in recommending the right machine and devising the proper fixture and insert arrangement for low unit cost.

*The broach tools literally wrap around the rod end of the forging, broaching surfaces on four sides at the same time.

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With Collective Bargaining Established Union's Next Step Is Management Control

By Leonard Westrate

ALTHOUGH the extent of pay increases is an important issue in the General Motors strike, it is not the most significant one. The primary and all-important fight is over what yardstick shall be used in arriving at wage rates. A clash of philosophies is involved that is so far-reaching and significant to American industry that all other issues are secondary. To most close observers the present struggle is much more fundamental and significant than the strikes over collective bargaining in 1937. If the union is successful in its contention that wages shall be directly proportionate to profits and that prices of the company's product shall be a factor in negotiations, the entire wage basing structure that has prevailed over the years will collapse. It will be replaced by a system giving labor a measure of control over wages, prices, and profits. That is the ultimate objective of the UAW-CIO—a voice in the affairs of management. That is what the fight is all about. And that also is why General Motors in a sense is fighting the battle for all American industry and the free enterprise system.

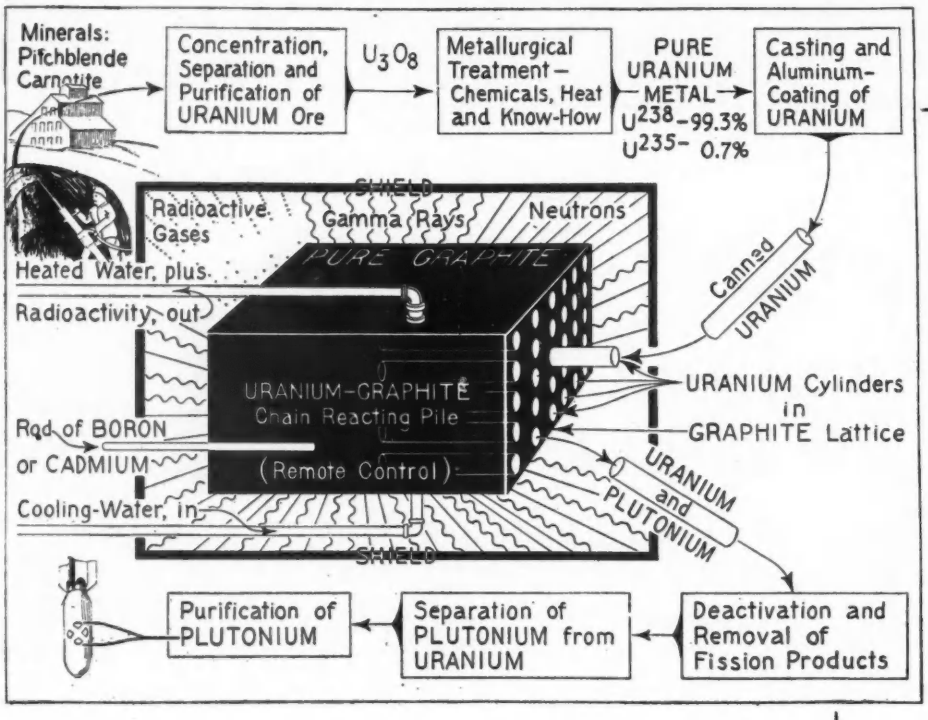
It still is conjectural as to whether the strike will be of long duration or will be settled within a reasonable time. The general opinion is that it will run a long time unless the union modifies its demands to have access to company records and to tie wages, profits and prices together. It now seems obvious that as long as there is no common ground on which the two parties can meet there will be little basis for settlement. If it were only a matter of arriving at a wage increase through traditional methods of collective bargaining without introducing profits or prices, the strike probably would not have occurred at all or at least would have been short. When the strike was called the union already had in its pocket an offer of a flat 10 per cent increase for all hourly rated workers. This is ample evidence that General Motors was willing to bargain the matter of wages. However, the offer was turned down because the corporation refused to comply with a union dictum that any wage increase would not be used as a basis for asking increases in prices.

All indications are that General Motors will not retreat from its adamant stand on opening its books or agreeing to any union dictated pricing policy on its products. It is the corporation's view that these are not properly any concern of the union.

George Romney, general manager of the Automobile Manufacturers Association, reports that before the General Motors shutdown production of 300,000 cars and 100,000 trucks already had been lost because of suppliers' strikes. Up to November 20 the industry had faced 283 strikes or slowdown interferences with production, five large vehicle manufacturers were down, and strikes had halted or crippled production in 111 cases. In 164 automotive plants strike votes had been taken and production was on a day-to-day basis with strikes expected at any moment. Slowdowns were being used in the plants of three major suppliers in order to force acceptance of union demands.

It now is obvious that the economic blockade plan which the union had figured would force quick capitulation has backfired. In the first place, General Motors furnishes components to all other automobile companies, and the AMA reports that the general strike at the corporation will close down all but one company sooner or later. The exception is Ford, which buys fuel pumps from General Motors, but also has an alternate source of supply that will permit operation on a more or less limited basis. Another factor is that with strikes in the glass and bearing industries, it is doubtful that production can go on much longer unless these stoppages are settled. Manufacturers have been operating on a hand-to-mouth basis

(*Turn to page* 106, *please*)



THIS schematic-drawing, prepared by F. K. Morris, shows the major steps in the production of plutonium. After the mining of pitchblende, carnotite or some other uranium mineral, this ore is treated to produce pure uranium metal, which is then cast into bars and these in turn are coated with a thin impervious layer of highly pure aluminum to protect the uranium from direct contact with the cooling water. The "canned" uranium is placed in a graphite pile, the size of which is precisely determined with just slightly more uranium in it than the critical

By Dr. Clark Goodman
Massachusetts Institute of Technology

Utilization o

THE successful development of large-scale sources of atomic energy was carried out under the compelling stimulus of war. Hence, military applications have preceded peace time utilization. The construction of atomic bombs is naturally not public information. However, from a consideration of the fundamental principles, it is evident that the explosive material in an atomic bomb consists of separate pieces of U-235, plutonium, or other fissionable substance—each of which is below the critical size. Detonation occurs practically instantaneously when the parts of the bomb are suddenly combined into a compact super-critical mass. The explosion produces an extremely rapid rise in temperature, the particles in violent motion being the nuclear fission fragments. All immediately surrounding materials are made incandescent, thereby producing a blinding flash, far more intense than the sun itself. The surrounding air is heated to such a degree that a fiery sphere of glowing gas rises rapidly from the scene of the explosion, and vents itself and practically all of the active materials into the stratosphere. The accompanying pressure wave and heat radiation devastate essentially everything within a radius of several miles.

From both military and industrial points of view, it is important to realize that there are no pea-sized atomic bombs. Nothing less than the critical size* will work. Hence, the explosion is one of Hiroshima proportions, or none at all. It is evident that these super-explosives will necessitate revolutionary changes in modern warfare. Even more evident is the need for international understanding.

The fission reaction releases about 32 billion Btu per pound of U-235 or plutonium, and the radioactive decay of the fission products releases an additional 8 billion Btu. This energy is more than a million times the heat of combustion of a good grade of coal (14,000 Btu per pound) or of 100-octane gasoline (22,000 Btu per pound). Yet the enormous amount of heat produced in the present piles is wasted. By means of heat exchangers, it probably would be relatively simple to use some of this energy for household or other low-temperature heating. For obvious reasons, few if any houses or factories are located near these piles. In order to utilize such heat for industrial purposes, it would be necessary to operate the pile at temperatures comparable to those of modern steam power plants. Apparently, the problems involved in this transition are very large. Dr. Smyth has summed them up in a statement that "the technological gap between producing a controlled chain reaction and using it as a large-scale power plant is comparable to the gap between the discovery of fire and the manufacture of a steam

This article is from the paper, "Petroleum vs. Plutonium," presented by Dr. Goodman at the 1945 Annual Meeting of the American Petroleum Institute.

* The critical sizes for various materials are military secrets. Prior to the war it was estimated that a sphere of U-235 of six in. in diameter might be sufficient to sustain a chain reaction. This amount of U-235 would weigh about 100 lb. The H. D. Smyth report, "A General Account of the Development of Methods Using Atomic Energy for Military Purposes under the Auspices of the United States Government 1940-1945," implies that somewhat less than 100 kg is necessary.

amount to maintain a chain reaction. When the pile has been assembled to the proper size it is triggered by the stray neutrons from cosmic radiation to start the fission activity, which increases to a high intensity, releasing a lot of energy in the form of heat.

The predetermined size of the pile has been so precisely established that even a small rise in temperature increases the surface that provides an important limiting effect on the spontaneous action of the pile. In addition the temperature is limited by alloy rods high in boron or cadmium that soak up neutrons and are moved in and out of the pile for vernier control. Large amounts of cooling water also must be provided to control the temperature. At the Hanford plant in Washington an appreciable rise in the temperature of the Columbia River takes place when one of the piles is operating, so great is the amount of heat received from this pile. Production of a pound of plutonium per day releases energy in the form of heat at the rate of about one million kilowatts.

At some optimum concentration of plutonium during the fission process within the pile, the bars of uranium containing plutonium and other fission products are removed. The pile and its products are intensely radioactive and being extremely dangerous to personnel, operation of the pile and chemical treatment of the uranium, after removal from the pile, must be carried on by remote control within air-tight concrete shields several feet in thickness. The relatively small amount of plutonium is separated from the bulk of the parent uranium, after which the plutonium is purified and is then ready for the atomic bomb.

n of Atomic Energy

locomotive." Those intimately acquainted with the operation of the piles probably know many limiting factors. The following are among the more obvious ones:

a. The capture of neutrons by U-235 would decrease because of the increase in velocity with rise in temperature.

b. The corrosion of aluminum and other metal parts probably increases rapidly with temperature.

c. Shutdowns are very serious; yet the pile must operate not only by remote control, but also without maintenance or repair. Operation at higher temperatures would undoubtedly increase the number of shutdowns.

d. The thermal conductivity of uranium and graphite may impose major restrictions on the practicable temperatures.

If developments in this field are allowed to flourish unhampered by military restrictions and government controls, it seems probable that these problems can be solved in a reasonably short time, and that atomic energy will be available for industrial purposes within the next decade. The question will then be: can atomic power compete with petroleum, coal, and water power on an economic basis? Too many unknows are involved to allow other than speculation, but in all likelihood the answer will not be clearcut.

Inasmuch as coal is the most economical fuel for large installations, it would appear that natural uranium piles may compete with coal, particularly in the generation of electric power. The piles could be located near the populated areas, but sufficiently remote to prevent radiation hazards. The heat released would be used to produce steam to drive turbo-electric generators. This electric power would actually be a by-product from the production of plutonium and radioactive fission materials and the treatment of substances by radiation. As in all of these speculations, the economics depend upon the demands for and the restrictions on the use of fissionable materials. Some of the heat from these large piles also might be used to operate thermal or diffusion plants for separating U-235 from uranium.

The natural uranium and graphite piles, which may compete with coal, are far too bulky to be used in units for mobile power. By using uranium that has been enriched in U-235, or to which plutonium has been added, the size of the pile can be considerably reduced. The use of heavy water (deuterium oxide) as a moderator in place of graphite also allows substantial reduction in size. Although heavy water is more expensive and difficult to obtain than graphite, piles containing this liquid moderator have been built at Chalk River, Ontario, and at the Argonne site near Chicago.

With the decrease in size of power units, the competition with petroleum would probably begin in replacing fuel oil in large transports and naval vessels.

(*Turn to page 62, please*)

Experimental

Verification

of Cumulative

Fatigue Damage

PROGRESS with methods of fatigue analysis has been slow because of lack of basic information on material behavior and, more important, because no method of handling any but the simplest problem has been available. Any solution requires several tools before other than a simple comparative analysis based on tests can be made. Even in comparative tests the experiment easily may be over-simplified to the extent that significant effects are completely lost. These tools must provide:

1. Information on the loading conditions to be encountered (number of cycles, frequency of occurrence of gusts, etc.).
2. Information regarding the number of cycles to failure of the material or part at various stresses, i.e., S-N curves.
3. Means for evaluating the cumulative effects of cycles of stress at various stress levels.
4. A method of relating various loading cycles (i.e., cycles of stress with different ratios of minimum to maximum stress).

Item 1 of this list is a general problem of a magnitude beyond the scope of the laboratory experimenter, the designer, or the stress analyst. They must rely upon service information where available or otherwise make conservative loading estimates. This problem is very important but must be undertaken on a larger scale than is possible here.

Item 2 is obtainable experimentally in most cases and data can be augmented with instrumentation of parts in service and carefully prepared service records.

The principal purpose of this article deals with Item 3, a means for evaluating the cumulative effects of cycles of stress at various stress levels.

B. F. Langer (Ref. 1) presented a method for estimating the effects of loading cycles of different stress amplitudes in 1937. The propagation of a crack is related to a damage curve obtained as in Ref. 2 or to the start of a crack. Langer also suggested certain experiments to verify the proposed calculation. In Ref. 2, page 205, a discussion of the work of Thum and Federn, Bollenrath, Nissen and Kaul indicated trends of thought toward establishing a cumulative damage approach to fatigue failure. Thum and Bautz also discussed some of the aspects of this problem in Ref. 3.

Consideration of these various approaches led to an attempt to simplify the various phases of the damage problem in fatigue. Since aircraft structures are mainly made of aluminum alloys, this material was chosen for the tests although alloy steels are still very important. Also, the appearance of a crack in an airplane structural member has required repair or replacement before further operation was possible; thus a crack can be considered as a failure in an aircraft structural component. To account for the effects of stress cycles above some arbitrary lower limit (for

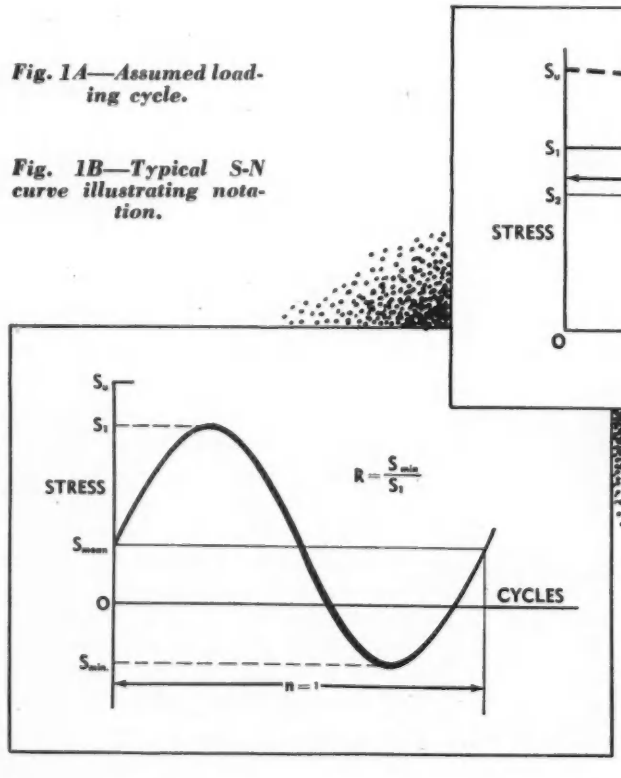


Fig. 1A—Assumed loading cycle.

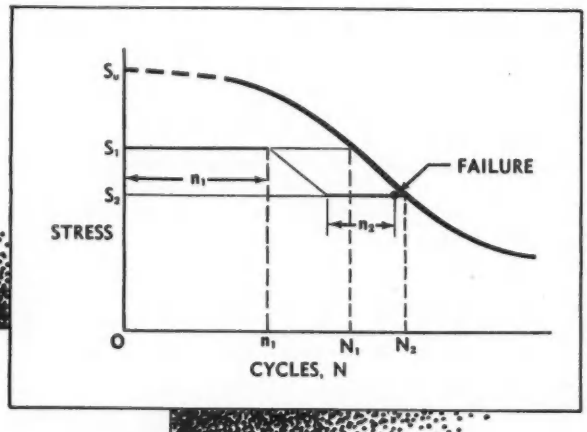


Fig. 1B—Typical S-N curve illustrating notation.

By Milton A. Miner
Strength Test Engineer,
Douglas Aircraft Co., Inc.

THE phenomenon of cumulative damage under repeated loads is assumed to be related to the net work absorbed by a specimen and the number of loading cycles applied, expressed as a percentage of the number to failure at a given stress level, is the proportion of useful life expended. When the total damage as defined by this concept reached 100 per cent, the fatigue specimen should fail. Experimental verification of this concept for an aluminum alloy using different types of specimens, various stress ratios, and various combinations of loading cycles is presented in this article.

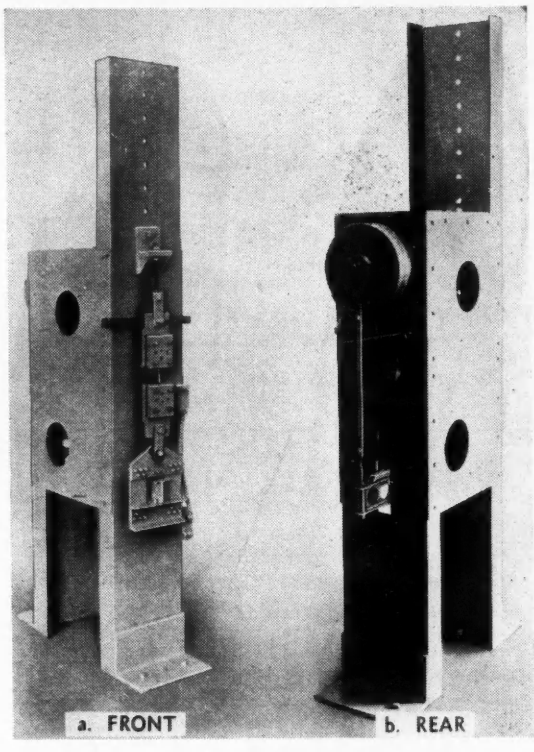


Fig. 3—Axial loading fatigue machine (strain gage ring not shown).

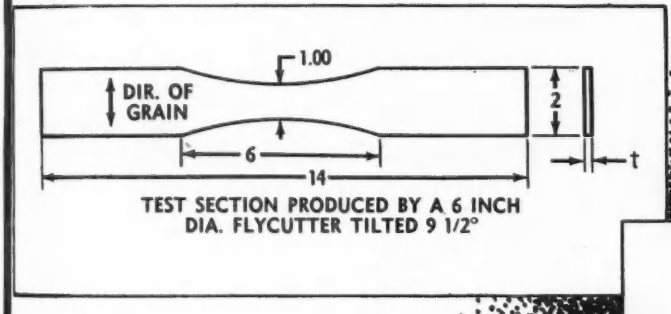


Fig. 2A—Flat sheet fatigue specimen.

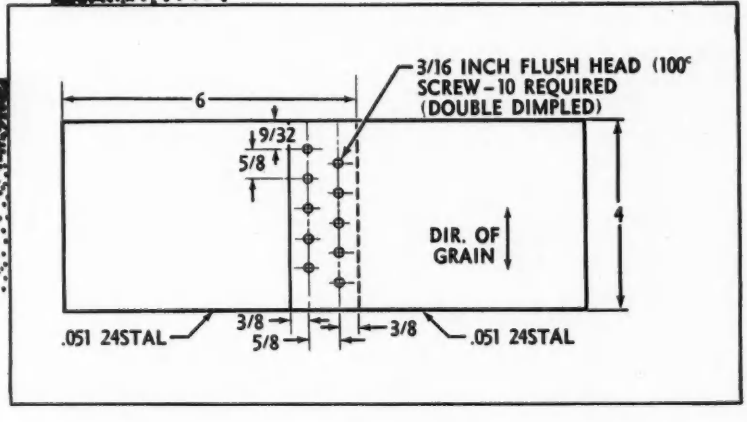


Fig. 2B — Dimpled flush screw fatigue specimen.

convenience say the stress at $N = 10^7$) a very simple concept of damage was first considered. This concept held that the damage could be expressed in terms of the number of cycles applied divided by the number to produce failure at a given stress level. When the summation of these "increments of damage" at several stress levels became unity, failure occurred.

It should be noted that the significant feature of the cumulative damage concept lies in the hypothesis that failure occurs when $\Sigma \frac{n}{N} = 1.$

The results for the sake of experimental brevity are subject to the following limitations:

1. Only aluminum alloys are to be studied
2. Only maximum stresses above the stress at which fatigue failure occurs at 10^7 cycles are to be considered

Referring to Figs. 1A and 1B

S = either maximum or minimum stress
S_u = ultimate static tensile strength
S_1 = maximum stress in a loading cycle
N_1 = number of stress cycles to failure at stress, S_1
n_1 = number of cycles applied at S_1
W = work done to failure
W_1 = work done at n_1 cycles
S_{min} = minimum stress in a given loading cycle
R = ratio of minimum stress to maximum stress in a loading cycle,

$$R = \frac{S_{min}}{S_1}$$

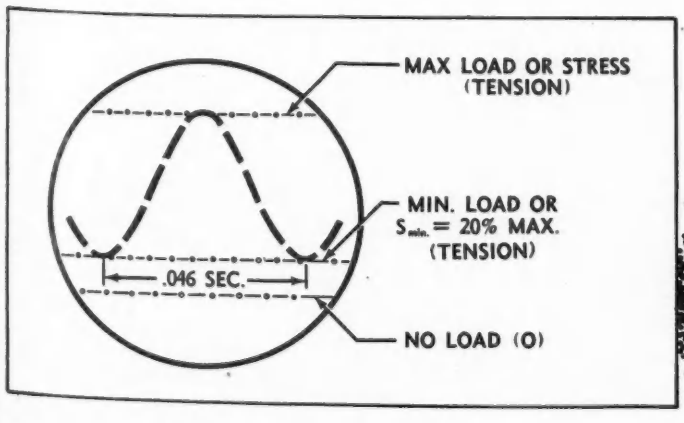


Fig. 4—Actual trace of stress-time wave form from oscilloscope recorder.

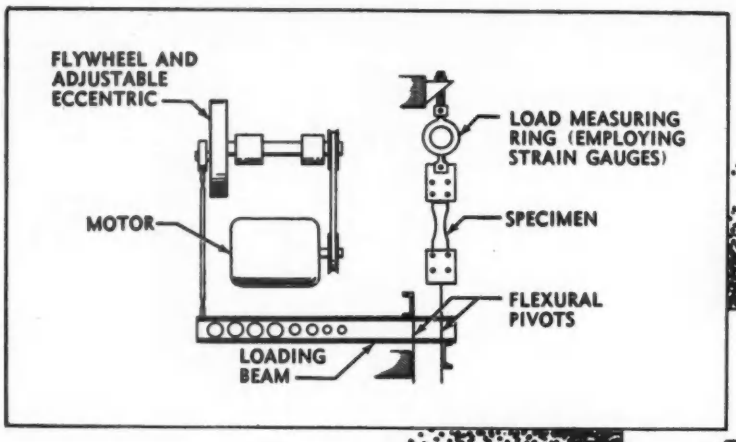
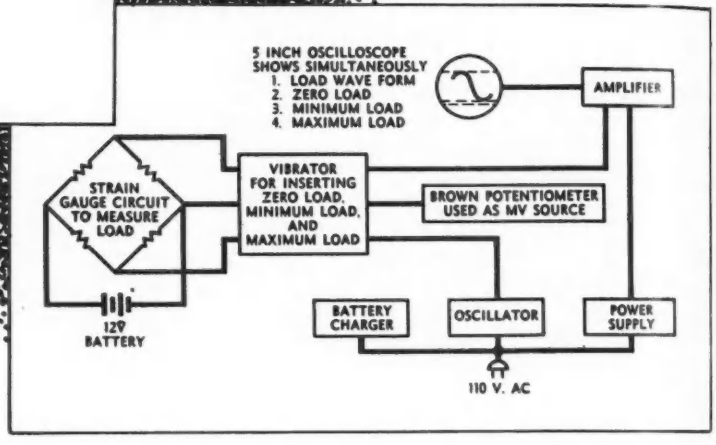


Fig. 5A—Line diagram of typical fatigue machine.

Fig. 5B—Line diagram of load control circuit.



In Figs. 2A and 2B are shown the types of specimens employed in the experiments. It should be noted that all specimens were made from Alclad 24ST sheet material.

The equipment used to perform these tests was essentially the same as that shown in Fig. 3 and in the line diagram of Fig. 5A. Positive dynamic load control was maintained through the use of electrical resistance strain gages coupled in series with the test specimen and indicated on a DuMont type 208 five in. tube cathode-ray oscilloscope (Figs. 4 and 5B).

The basic S-N curves are shown in Fig. 6. Stress ratio values, $R\left(\frac{\text{minimum stress}}{\text{maximim stress}}\right)$ of +0.50, +0.20, and —0.20 determined experimentally are presented. Fig. 7, a reproduction of a portion of Fig. 6 with results

TABLE I

Spec. No. and Type	Maximum Stress psi or Load*	n cycles 1000	N cycles 1000	n/N	Σ n/N	Remarks
1-B	1. *4300#	7.2	31.5	.44		Load decreased to 2.
	2. *3515	15.6	64	.24		Load decreased to 3.
	3. *2735	120.0	155	.77		Failure
					1.45	
2-B	1. *2735#	72.0	155	.46		Load increased for 2.
	2. *3515	20.0	64	.31		Load increased for 3.
	3. *3900	1.2	45	.03		Failure
					0.80	
S-19-A	1. 33,300	135.0	243	.55		Load reduced to 2.
	2. 29,600	141.0	330	.43		Failure
					0.98	
S-20-A	1. 33,300	135.0	243	.55		Load reduced to 2.
	2. 25,000	308.0	640	.48		Failure
					1.03	
S-21-A	1. 33,300	135.0	243	.55		Load reduced for 2.
	2. 22,500	1,330.0	3,000	.44		Failure
					0.99	
S-22-A	1. 30,000	180.0	320	.56		Load increased for 2.
	2. 33,300	108.8	243	.44		Failure
					1.00	
S-40-A	1. 30,000	128.0	320	.40		Load increased for 2.
	2. 50,000	29.9	85	.35		Failure
					0.75	
S-42-A	1. 30,000	108.0	320	.34		Load decreased for 2.
	2. 27,500	97.5	420	.23		Load increased for 3
	3. 32,500	9.1	260	.04		Failure
					0.61	
S-43-A	1. 25,000	102.5	640	.16		Load increased for 2.
	2. 35,000	55.5	215	.26		Load decreased for 3.
	3. 27,500	97.5	420	.23		Load increased for 4.
	4. 32,500	26.9	260	.10		Failure
					0.75	
S-48-A	1. 35,000	100.0	215	.46		Load decreased for 2.
	2. 30,000	100.0	320	.31		Load decreased for 3.
	3. 27,500	230.0	420	.55		Failure
					1.32	
S-49-A	1. 27,500	200.0	420	.48		Load increased for 2.
	2. 30,000	80.0	320	.25		Load increased for 3.
	3. 35,000	82.5	215	.38		Failure
					1.11	

Notes: 1. Stress ratio $\left(\frac{\text{minimum stress}}{\text{maximum stress}}\right) = +0.2$ for all specimens.

2. Specimen type A is illustrated in Fig. 2A and type B in Fig. 2B.

Average value of $\Sigma \frac{n}{N} = 0.98$ in Table I.

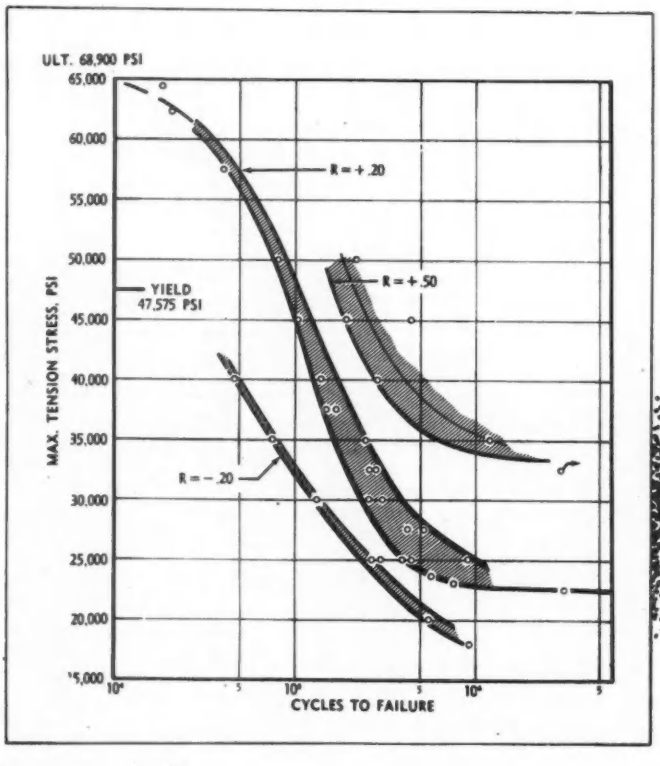


Fig. 6—S-N curves at various R values for Alclad 24ST.

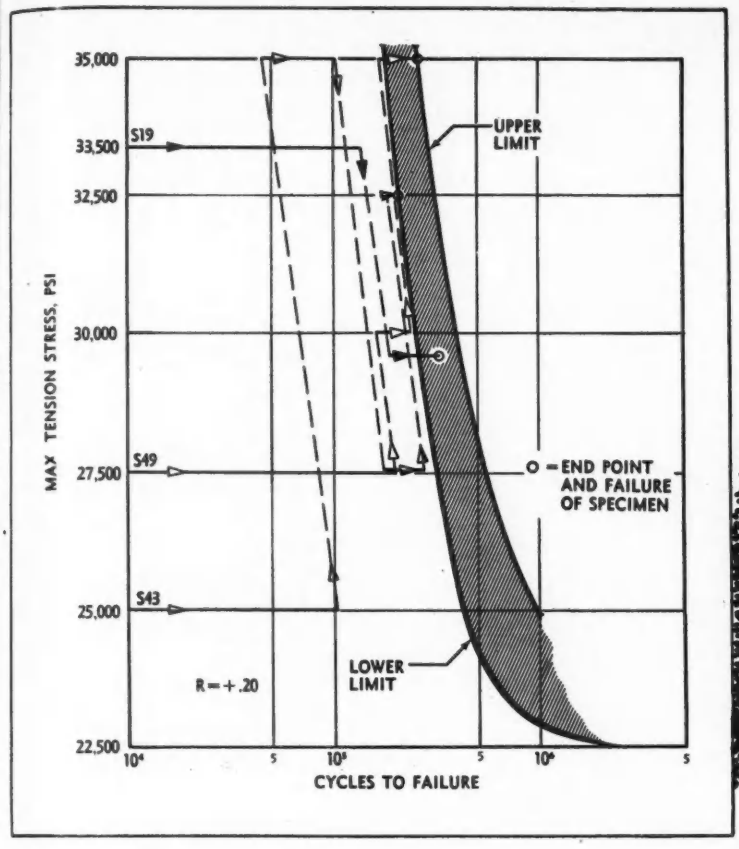


Fig. 7—Partial reproduction of Fig. 6 giving a graphical presentation of the cumulative damage concept for a few typical samples.

for three typical specimens from Table I, is plotted to illustrate graphically the loading cycles employed and the agreement of the final failure with the cumulative damage concept.

The method of plotting the cumulative cycles in Figs. 7, 8, and 9 is based on the proportion, $\frac{n}{N}$. At any ratio of $\frac{n_1}{N_1}$, a percentage of useful life has been consumed. This proportion is used to determine the starting point of n_2 at a different stress. Thus specimen S19 was run at 33,300 psi for 135,000 cycles. Since $N_1 = 243{,}000$ cycles,

$$\frac{n_1}{N_1} = \frac{135{,}000}{243{,}000} = 0.55,$$

and at the lower stress of 29,600 psi, this was equivalent to $0.55 \times N_2 = 0.55 \times 330{,}000 = 181{,}000$ cycles, which is the point from which n_2 starts on Fig. 7. Now since $n_2 = 141{,}000$ cycles at failure, $\frac{n_2}{N_2} = \frac{141{,}000}{330{,}000} = 0.43$ and the value of $\Sigma \frac{n}{N} = 0.98$. This same procedure is used to plot the other points serving as examples.

Table I presents the results of a number of experiments, all of which were run at two or more stress levels at a stress ratio of +0.20, the average test value for $\Sigma\frac{n}{N}$ is 0.98. The maximum and minimum values are 1.45 and 0.61. If only the last cycle of loading is plotted for these tests (assuming that only this final stress cycling caused the failure), the average value of $\frac{n}{N}$ is 0.37, thus indicating that the damage from the other loading cycles cannot be ignored.

Fig. 8 is representative of a more complex type specimen (in this case a dimpled flush screw joint) in which the S-N curve has been established and two tests have been run at different stress levels.

It should be pointed out at this point that the author believes that "stress-raisers" or stress concentrations are best handled in fatigue by experimentally establishing S-N curves on specimens or parts which contain the actual concentrations wherever possible. Applying factors or corrections does not seem feasible at the present time.

Table II presents results of experiments in which a percentage of damage was imposed upon a specimen at one stress ratio, R, then in most cases the stress ratio and load were changed and the specimen tested until failure occurred. In several cases, three dif-

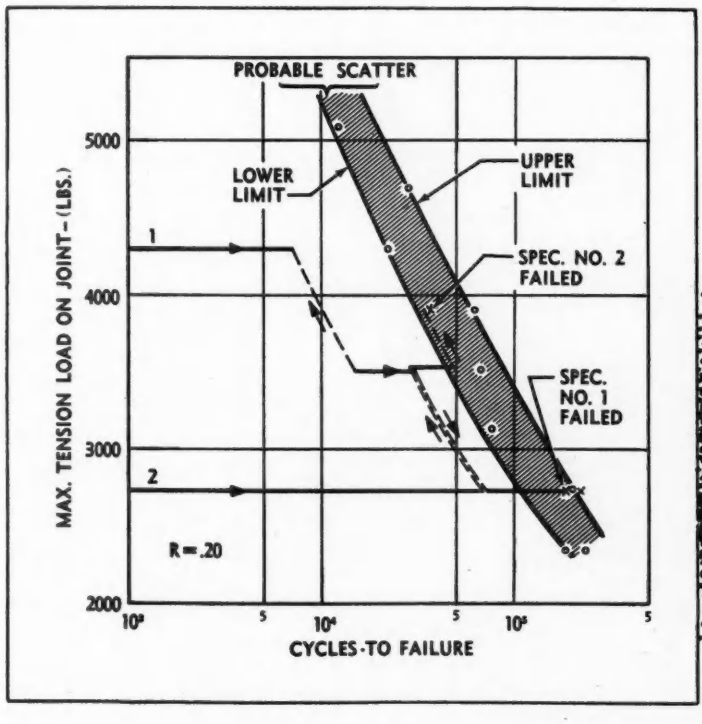


Fig. 8—Load-cycle curve for 3/16 in. Flush screw dimpled joint in 24STAL.

ferent stress ratios were employed both in the positive and negative range (i. e., both tension-tension and tension-compression loads). As in the case of tests run at a constant stress ratio, the value of N is taken directly from the *S-N* curve; the difference here being that S-N curves are required for each stress ratio.

Fig. 9 presents several of the results from Table II in graphical form. It is to be noted that the average value of $\Sigma \frac{n}{N}$ is 1.05 for these experiments. The maximum and minimum values are 1.49 and 0.80.

Although only 22 tests are presented in the results of Tables I and II, other data are available which further tend to confirm the results herein presented. The concept that damage in fatigue is cumulative and is proportional to the work done on the specimen (neglecting the effects of work hardening) would appear at first glance to be disproved by several previous works on aluminum alloys. However, the data in Ref. 5 when readjusted give an average value of $\Sigma \frac{n}{N}$ of 1.05. This is done by simply shifting the basic S-N curve very slightly (entirely within the region of mean test values). The single test result presented in Ref. 6 cannot be checked without access to the corresponding S-N curve; however, it is likely that since $\Sigma \frac{n}{N} = 2.00$ based on the lowest stress for the material, a value of not over 1.50 would be reasonable if the mean stress value were used.

The practice of overstressing specimens for some number of cycles then running to failure (or "running out") at the endurance limit is usually used to prove the presence or lack of damage (Ref. 2). This procedure obscures the results quantitatively in terms of the cumulative damage concept because of the very wide scatter of test points in the region of the endurance limit. For this reason no accurate picture can be drawn as to the validity of the concept for materials other than Alclad 24ST aluminum alloy because of lack of test data. Some investigators have had individual test specimens run beyond the S-N curve during the "over-stressing" run

(*Turn to page 56, please*)

TABLE II

Spec. No. and Type	R	Maximum Stress psi	n cycles / 1000	N cycles / 1000	$\Sigma \frac{n}{N}$	Remarks
S-38-A	−0.20	1. 35,000	33.0	80	.41	Load decreased for 2.
		2. 27,500	108.7	187	.58	Failure
					= .99	
S-39-A	−0.20	1. 27,500	127.0	187	.68	Load increased for 2.
		2. 40,000	6.3	48	.13	Failure
					= .81	
S-54-A	−0.20	1. 40,000	20.0	48	.42	R changed.
	+0.20	2. 40,000	50.0	155	.32	R changed.
	+0.50	3. 40,000	143.0	430	.30	Failure
					=1.04	
S-55-A	−0.20	1. 30,000	40.0	137	.29	R changed, load increased.
	+0.20	2. 32,500	80.0	260	.31	R changed, load increased.
	+0.50	3. 40,000	80.0	430	.19	Failure
					= .79	
S-56-A	−0.20	1. 35,000	40.0	80	.50	R changed, load decreased.
	+0.20	2. 32,500	149.5	260	.57	Failure
					=1.07	
S-57-A	−0.20	1. 37,500	40.0	63	.64	R changed, load decreased.
	+0.20	2. 25,000	423.0	640	.66	Failure
					=1.30	
S-58-A	+0.20	1. 25,000	312.0	640	.49	R changed, load increased.
	−0.20	2. 37,500	56.8	63	.90	Failure
					=1.39	
S-59-A	−0.20	1. 40,000	30.0	48	.63	R changed, load decreased.
	+0.20	2. 26,700	83.0	460	.18	Failure
					= .81	
S-60-A	+0.20	1. 26,700	200.0	460	.43	R changed, load increased.
	−0.20	2. 40,000	46.2	48	.96	Failure
					=1.49	
S-62-A	−0.20	1. 40,000	35.0	48	.73	R changed, load reduced.
	+0.20	2. 26,700	32.5	460	.07	Failure
					= .80	
S-63-A	+0.20	1. 25,000	350.0	640	.55	R changed, load increased.
	−0.20	2. 37,500	23.8	63	.38	Failure
					= .93	

Average Value for $\Sigma \frac{n}{N}$ = 1.05 in Table II.

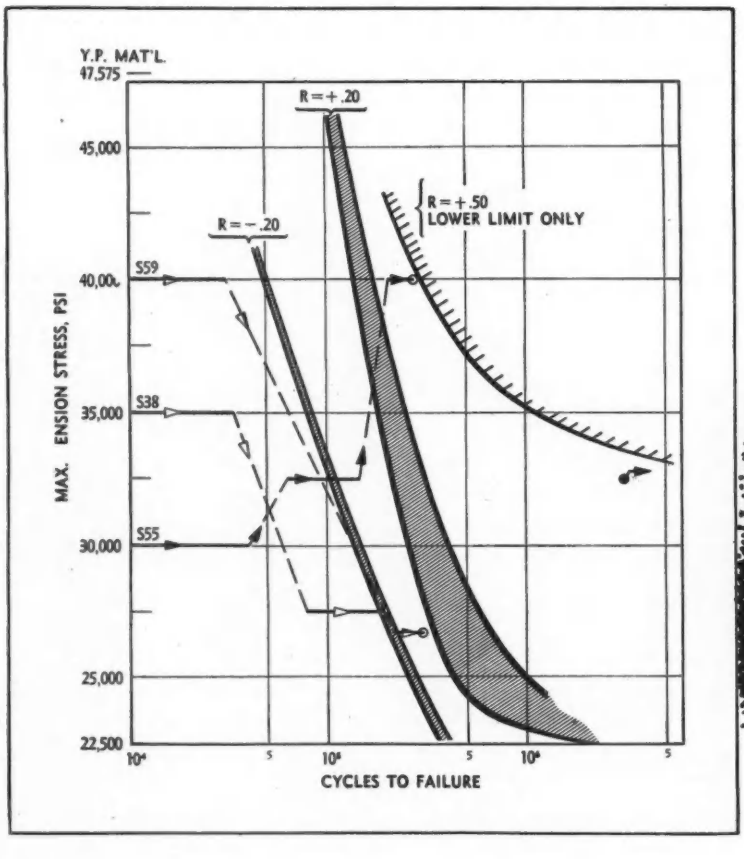


Fig. 9—Partial reproduction of Fig. 6 showing graphically the failing points for a few typical specimens with stress, stress ratio (R) and number of cycles all varying.

New Applications of Glue in the Automotive Field

By H. B. Sweatt
Secretary, Natonal Association of Glue Mfrs., Inc.

THE automobile more than any other product has come to symbolize the focal or meeting point of American industry. A thousand different skills and a hundred thousand different products from all parts of the country and, in normal times, the globe, flow into the huge manufacturing plants that turn out the world's best cars. Many of the products are comparatively unknown to automobile users and to many men on the car assembly lines. One of these anonymous but important products is animal glue.

At one time an essential component of every wooden automobile body as a tough and durable adhesive, glue, rather than disappearing with the advent of the all-steel car, has found many new uses in the modern vehicle. More recent applications finding their way into the new post-war cars include insulation, upholstery work, safety glass, and interior decoration.

To provide effective insulation against summer heat, steel shavings bound with animal glue will be used just under the steel roof. Upholstery coverings adhered to body frames with glue instead of tacks make for smooth, even appearance as well as durability. Glue bindings are able to withstand pressures of several thousand pounds per square inch, and in addition, are capable of withstanding the shock of sudden tears and pulls.

Clear flexible glue is coming into use as a binder in laminated safety glass for automobiles, having been used successfully during the war for that purpose between the two transparent shells of the acrylic plastic nose on bombers. Striking grained finish of fine woods can now be duplicated on dashboards and other interior trim due to a novel printing process. Car designers borrowed from the graphic arts industry the technique of using a glue glycerine printing roller to transfer a wood grained finish from a zinc plate to a sheet of metal, subsequently formed for car interiors. Many car makers will produce their own graining rollers in order to control the quality of the finish.

Today, millions of pounds of animal glue in various forms, are used by the automotive industry. Examine any moving part of the automobile. Each has been ground or polished to a fine tolerance and high finish. This perfection of precision grinding and polishing made possible the rapid conversion of car assembly lines to the production of airplanes and other essential military items. Glue coated abrasive paper and cloth, and glue bonded polishing wheels are used to grind and polish crank and cam shafts, piston pins, cylinder boxes, and a variety of other mechanical parts. Flexible polishing wheels equipped with glue coated abrasives are now used to finish fenders and body in a fraction of the time formerly used to finish these surfaces by hand sanding. Precision grinding and polishing eliminates vibration, insures perfect lubrication, and provides for interchangeability of parts. In like fashion, bumpers, radiator grilles, fenders and other exterior parts are highly polished prior to painting or plating. In the chromium plating of bumpers, glue is mixed with electric plating solution to insure even deposits of the bright metal.

Interior Fabrics

Interrupted prewar trend to greater use of textiles in car interiors for beauty as well as durability has focussed attention on fabrics as one of the most important materials of the postwar car. Fabrics used for upholstery, shade, and floor covering purposes are all processed with animal glue. Rayon, for example, is one man-made yarn, that will find wider acceptance in tomorrow's car. As a synthetic yarn, rayon requires a sizing or protective coating during weaving to prevent abrasion of the yarn. Animal glue sizings are standard in rayon mills to provide the necessary protection and elasticity to allow normal weaving. When the yarn has been woven, it is treated with animal glue compounds to facilitate dyeing and also to promote greater resistance to water and grease. Improvements in dyeing techniques together with the progress made in the chemistry of dyes in the past few years has resulted in cloth dyeing of greater permanency than was dreamed of. Therefore, it will not be necessary to worry about exposure of many dyed fabrics and floor coverings to sunlight as may be the case during daytime driving.

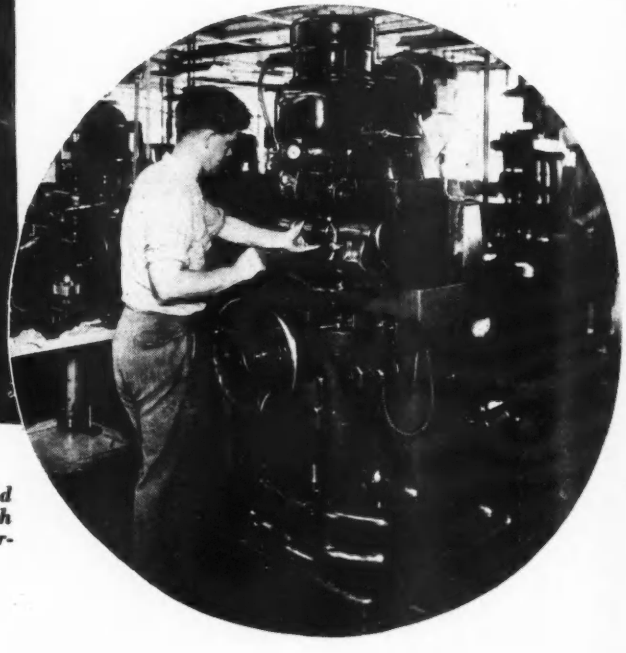
Prior to the outbreak of war, English manufacturers

(*Turn to page* 102, *please*)

(Left) The variety of water pump and oil pump shafts as well as fan spindles all are finish-ground to close tolerances on Cincinnati Centerless grinders. A group of these is seen in this department.

(Lower left) Typical of modern methods employed here is this Heald two-spindle Bore-Matic tooled for the precision-boring of water pump bodies.

This is the 112th in the series of monthly production features



(Circle) Supercharger gears are shaved on this Red Ring gear finisher which forms part of the equipment in the supercharger shop.

ONE of the finest examples of versatility among the parts makers of our industry is to be found in the Schwitzer-Cummins Co., Indianapolis, Ind., whose founder and president—Louis Schwitzer—is known to everyone in the field of internal combustion engines. The organization had its start in 1918 as The Automotive Parts Co., specialists in engine cooling and the manufacture of fans, oil pumps, and precision parts.

Since then the company has branched out into many diversified activities. Even if we confine ourselves to automotive products the present line includes amazing variety, not only in kinds of products but in the range of sizes and types of each one. For example, in the shift from war contracts to postwar business, the company offers a full line of water pumps—for fresh or sea water—oil pumps, heavy duty fans, torsional vibration dampers, superchargers for gasoline and Diesel engines, and a unique line of Aqua-Tite automatic shaft seals for water pumps.

In seeking to serve every producer of gasoline and Diesel engines in the industry, the organization has had to develop the know-how and the flexibility of thinking and manufacturing so as to tailor-fit each of its products to the needs of the user. When you consider the range of models among commercial engine builders, the wide range of sizes from a tiny one-cylinder engine to heavy duty Diesels producing hundreds of horsepower, and the problems of installation for each one, it is easy to appreciate the complex nature of the manufacturing problem. When you add to these the extra complication of variability in production volume for each customer, you can visualize

By Joseph Geschelin

Schwitzer-Cummins

Plant Organized for Small Lot and Mass

Production of Engine Equipment

(Below) View of the special assembly machine developed and built by the company for the assembly of Aqua-Tite automatic water pump shaft seals. Note the use of two hopper fed magazines, one for the metal retainer, the other for the rubber housing.

the problem even better. For some accounts will buy only 500 water pumps a year whereas a few take 500 to 1000 per day. At the present writing there are 100 or more different water pumps alone on the going schedule.

To be a recognized specialist in this specialized field of engineering takes a combination of abilities and facilities. In the first place, Schwitzer-Cummins possesses engineering talents and laboratory facilities capable of contributing to progress in the development of internal combustion engines. They are responsible for originating advanced designs and for assisting engine builders in the application of the product to the best advantage. During the war these facilities played an important part in the development programs of the armed forces and in the solution of problems of cooling system design for combat vehicles of all kinds.

To translate the requirements of individual users into a physical product requires production know-how and suitable manufacturing facilities. It is amazing to the visitor to find the complexity of products from tiny oil pumps to large superchargers built under the same roof in a veritable beehive of machine activity. The secret lies, first in the skillful management of flexible machine tools of every known variety—mostly of general purpose type—then in the development of interchangeable tooling to make possible economical production runs, and finally in the skillful scheduling of the host of parts, large and small, so as to

(Lower right) The roughing of the supercharger contour by form-milling is done on this DeVlieg Supermil.

meet schedules smoothly and without interruption.

Actually the physical plant combines the features of lot production and mass-production. Within the framework of a plant which has been departmentalized to facilitate short run production of a wide variety of parts there are found self-contained departments tooled for the manufacture of single mass production parts. Thus the major elements of assemblies required in lots of say 500 to 1000 per day are made in a compact department from start to finish. These departments are provided with the necessary machinery — sometimes of single-purpose character— fitted with permanent tooling capable of high productivity.

In anticipation of postwar expansion, there is under construction at the writing of this article a new engineering building. This will centralize the facilities for design and research and development—the engineering department, research department, chemical and metallurgical laboratories, model building, and the like. Schwitzer-Cummins is a pioneer in the field of superchargers—both of positive displacement and centrifugal types. For many years superchargers have been made in rather small volume and for a limited number of engine builders. Anticipating an increasing adoption of supercharging on engines for all purposes, the company is in process of building a large self-contained department equipped with entirely new and modern production machinery. This will be capable of meeting the demand for every variety of superchargers in the full range of sizes and in keeping with the growth of volume.

Due to the extensive production setup the best that can be done in a short article is to select a few representative parts and show how they are made. It may be noted in a general way that the plant is departmentalized so as to permit an uninterrupted flow of parts over the machine lines. As examples of this are: a large automatic screw machine department containing a big battery of multiple-spindle National Acme-Gridley machines; and a fully equipped press shop for producing stampings for fan blades, spiders, and hubs, for ventilating equipment,

Factory Routing Water Pump Cradle

OPERATION AND EQUIPMENT

Anneal. Water test cradle body. Water test impeller clearance.

Clamp in a special pot fixture. Bore and ream 1.6255 +0.000 −0.001. Bore 1¼ diam.. Counterbore and ream 1.5005 +0.000 −0.001 diam. Face end and chamfer. Turn 3.498 diam. pilot, flange and undercut—**New Britain chucking machine.**

Finish grind 3.498 +0.000 −0.002 diam. pilot and true up face of flange—**Fitchburg external grinder.**

Clamp on special operated face plate fixture locating in reamed hole and against flange. Face flange to 3-29/32 from other pilot flange. Turn 3.687 +0.000 −0.002 diam. pilot. Face and chamfer. Bore 1-1/32 and turn 1⅝ diam. Rough and finish face seal face—**New Britain chucking machine.**

Core drill, fly-cut, face and ream distributor hole—**#15½ Foote Burt drill with 20 in. rotary table.**

Drill (8) 11/32 diam. holes, and (6) 13/32 diam. holes in flanges—**#13 Natco multiple-spindle drill.**

Drill and spotface (1) 5/16 hole for ⅜-16 tap. Drill (1) ½ hole. Drill ¼ hole at 40 deg. Drill (1) 3/16 hole at 30 deg.—**Cincinnati-Bickford 4-spindle drill with power feed.**

Mill ½ slot—**#1 Toledo hand miller.**

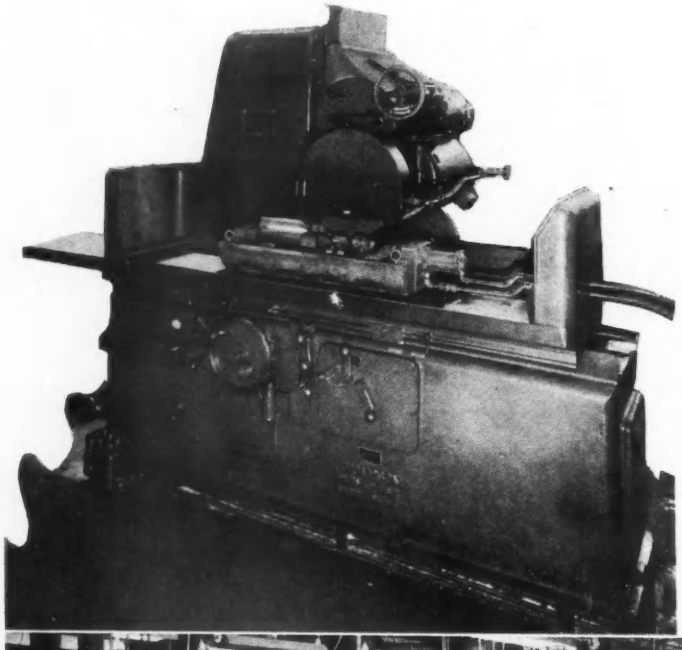
Tap ⅜-16 hole—**#2 Garvin tapper.**

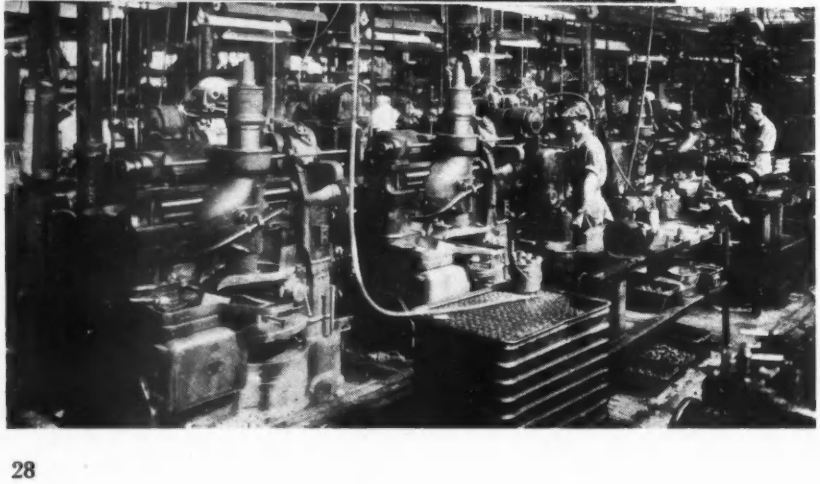
Wash. Press cork to retainer and retainer to cradle. Press in second retainer & press in bushing.

Line bore bushing—**Heald Bore-Matic.**

Place on finger chuck locating in line bored bushing hole. Finish face flange and turn 3.687 +0.000 −0.002 dia. pilot. Finish face seal face—**Sidney engine lathe.**

Check for runout.





(Top) Latest development in the machining of supercharger rotors is the adoption of this Thompson surface grinder for the final form-grinding of rotor lobes.

(Left) Here is part of a large battery of Fellows gear shapers of various models and sizes installed in the gear cutting department.

(Circle) New Ex-Cell-O precision boring machine installed in the supercharger department is used for boring the locating points for subsequent operations. This machine is of double-end construction, fitted with an indexing type fixture.

(Above) Close up of one of a battery of Gisholt turret lathes used for various jobs including the machining of water pump bodies.

(Top) Latest model Gisholt Dynetric balancing machine is used for the dynamic balancing of supercharger rotors.

Factory Routing Body Water Pump

OPERATION AND EQUIPMENT

Anneal. Water test & dip in soluble oil.

Chuck in form jaws on contour of OD. Rough bore 0.875 diam. 3.689 diam. 3.188 diam and face 1¼ hub boss. Chamfer and semi-finish bore 0.8755 diam.—**Potter & Johnston semi-automatic turret lathe.**

Drill & spotface (1) 11/32 pipe plug hole. Drill (1) 3/16 drain hole—**Delta 2-spindle drill press.**

Drill (4) G holes, (2) 5/16 holes and (1) 11/32 hole—**#12 Natco multiple-spindle drill.**

Disk grind flange pad—**20A Gorton disc grinder.**

Tap (4) 5/16-18 holes. Tap (2) ⅜-16 holes in flange—**#2X Garvin with multiple head (4 spindles) 2 tappers with multiple-Atlas S.S. Drill with tapping heads, single tapping head.**

Tap (2) ⅛ pipe plug holes—**#1 Garvin S.S. tapper.**

Wash and blow off.

Finish bore 0.8755 +0.000 −0.001, 3.188 +0.000 −0.002 diam. and 3.688-3.689 diam.—**Heald Bore-Matic 48A.**

Press bushing in place—**Arbor press.**

Fly-cut bush hole—**Heald Bore-Matic.**

for vibration dampers, and the variety of other stampings used in the different assemblies. Other equipment includes: New Britain chucking machines of various types, Gisholt turret lathes, Warner & Swasey turret lathes, Lodge & Shipley Duo-Matics, a Bullard Mult-Au-Matic, Heald internal grinders and Bore-Maties, Ex-Cell-O precision boring machines, Natco multiple-spindle drills, Cincinnati Centerless grinders and external grinders, Norton cylindrical grinders, and many other makes and types.

Gears for oil pumps and for superchargers are given special attention owing to the special requirements of quietness, freedom from back-lash, and durability under heavy loading. Most of the pump gears are cut on Fellows gear shapers of which they have a new battery of the small high speed models. The supercharger gears are hobbed, then shaved on Red Ring gear finishers. The organization takes particular pride in the quality of gears and shafts produced in this plant.

Cemented-carbide tools are widely employed in the machining of steel parts and iron castings. They are used to the fullest advantage in speeding productivity and producing fine surface finish.

Louis Schwitzer is particularly proud of the line

of Aqua-Tite automatic shaft seals developed for use in the pump assemblies made here and also supplied to manufacturers who make their own water pumps. This development stems from more than 20 years of pump making and the realization that the major inherent weakness of water pumps has been in leakage. Over the years many types of seals were developed and used, culminating in the adoption of the present design in which the former metal bellows has been replaced with a synthetic rubber sleeve to which is bonded a special alloy carbon block. It is claimed that such seals have been in service 150,000 miles without appreciable wear. The standard line consists of a metal retainer, housing a low rate compression spring and encased in synthetic rubber. The sealing flange is so formed as to provide extreme flexibility and is capable of self-adjustment for wear or for out-of-line conditions.

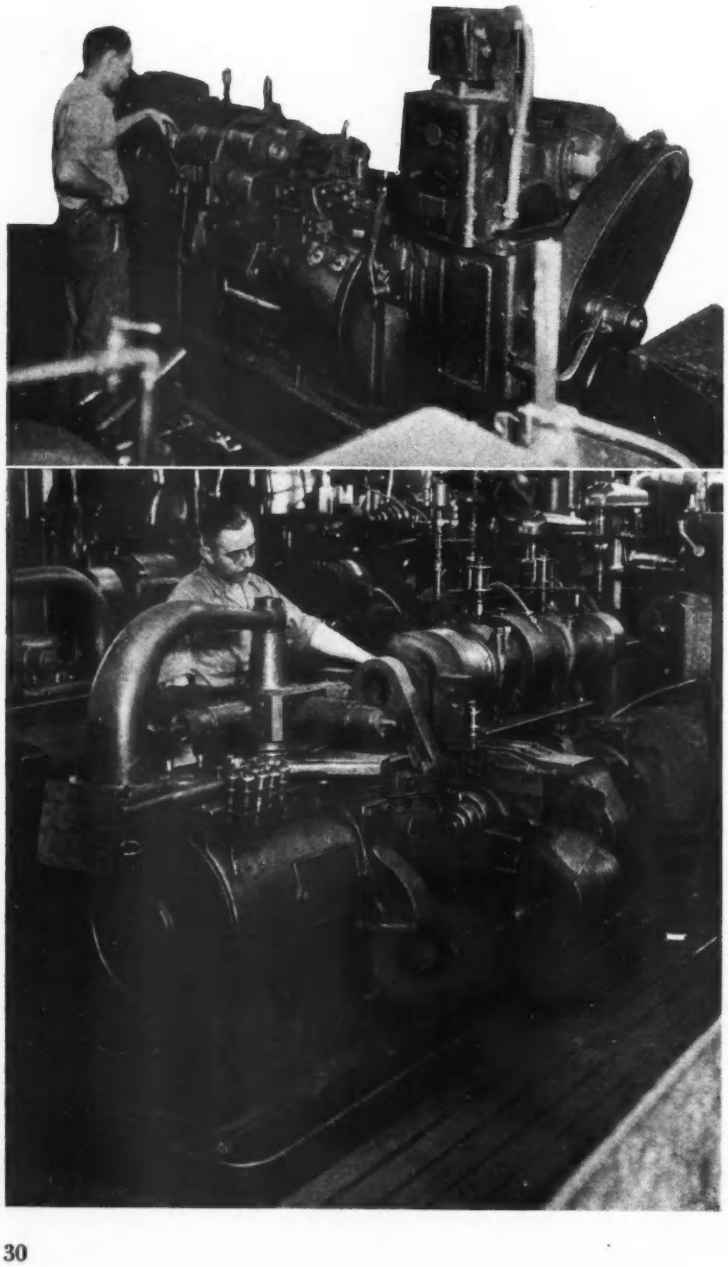
As an example of the team work of engineering and production, consider that when the seal was first placed in production the rubber housing had to be assembled over the metal retainer sub-assembly by hand. This was a difficult task indeed for the operators and even the most proficient could not assemble 600 per hour. Moreover, the operation caused considerable discomfort to operators. Since then the production department has built a special—and quite simple—magazine feed automatic assembly machine which turns out 2000 pieces per hour with facility. As illustrated, this machine has two magazines fed from individual hoppers. One feeds the metal retainer sub-assembly, the other supplies the rubber housing. At the assembly station, the mechanism is so arranged that collapsible fingers move in to stretch the rubber casing and while dwelling in that position, a ram or mandrel pushes the metal retainer into place and then ejects the assembly.

In the press shop some rather ingenious things are being done in regular production. A case in point is the fan hub—a deep-drawn cup of heavy stock which may run as much as five to six inches in depth in the stamping. Such parts are drawn in conventional presses starting with a blank in the form of a disc of suitable diameter. A typical hub is drawn in six operations, the first draw producing a shallow cup of large diameter without flanging. The flange begins its development at the third draw. Of particular interest is that by the use of properly designed dies and by working the metal in easy stages, the final stamping not only has uniform wall section but the section is of about the same thickness as the original blank.

Factory Routing Supercharger Rotor

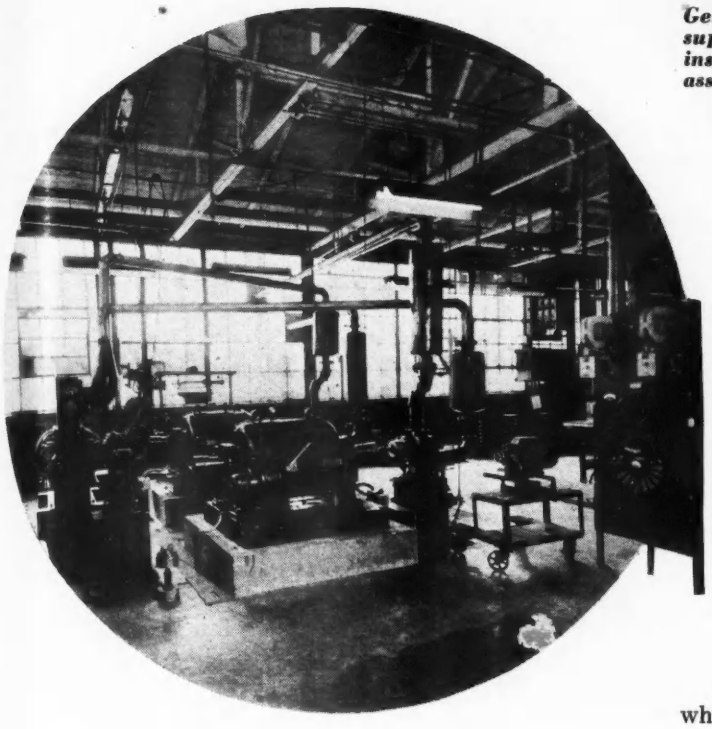
OPERATION AND EQUIPMENT

Rough mill ends—**Milwaukee duplex mill.**
Normalize.
Rough drill 3 end holes—**3-ft. Western radial drill press.**
Mill 4 locating flats—**Van Norman mill.**
Semi-finish 3 end holes—**3-ft. Western radial drill press.**
Finish bore center hole to size—**Ex-Cell-O precision boring machine.**
Place on arbor and semi-finish ends—**18-in. American engine lathe.**
Broach center hole—**American broaching machine.**
Locate from broached hole and bore (2) 1.000-1.002 holes—**Ex-Cell-O precision boring machine.**
Rough mill contour—**DeVlieg milling machine.**
Finish grind contour—**Thompson grinder.**



(Top left) High production setup for machining one of the water pump bodies includes a group of two New Britain chucking machines for facing, boring, and reaming pump bodies.

(Left) Another of the high production machines in the water pump department is this Potter & Johnston heavy duty turret lathe which is set up for first operation machining of water pump bodies —facing, boring, rough-boring.



General view of the dynamometer test department in the supercharger shop, showing the extensive equipment and instrumentation for the testing of finished supercharger assemblies. This operation is performed on every supercharger prior to acceptance for shipment.

The supercharger department specializes in precision work in every detail. In the first place, the housings and rotors are made of special analysis cast iron of high strength and freedom from porosity. The rotor specification is a high silicon (2.20 to 2.60 per cent) gray iron with manganese and molybdenum. This material is said to have outstanding wear resisting qualities. Painstaking attention is paid to the manufacture of the gears used in these units, to assure freedom from back-lash, lasting alignment, good wearing qualities, and above all, quietness under high speed operation.

The gear blank is machined from a forging, following the routing shown elsewhere. It is of interest to note that the blank is normalized before machining, then machined all over and heat treated before finish-grinding and before cutting the gear teeth. At the present writing the gear teeth are cut by hobbing. Later when the new and expanded department is in operation the teeth will be cut on Fellows gear shapers. The Red Ring gear shaver is used after gear cutting to correct the profile and assure quietness.

Some dimensional tolerances, indicating the degree of precision workmanship specified on the gear, may be of interest. The ground OD on a typical gear is held to 4.2000-4.1995 in.; the bore is held to 1.375-1.3755 in. Exacting also is the alignment of the faces of the web and the sides of the blank, with respect to the pitch line axis. These blank surfaces are specified to be held square with the pitch line plus or minus 0.0005 in. indicator reading.

As illustrated, the rotor is a two-lobed casting held to fine tolerances at various points. The center bore as well as the two bores in the lobes are precision-bored in an Ex-Cell-O double-end unit using cemented-carbide tools. Precise alignment is assured thereby since the rotor is held securely in the indexing fixture while boring first from one side then the other.

The contour of the lobes is rough-milled in a DeVlieg automatic milling machine, using a large special formed milling cutter for the purpose. Then the contour is ground to exact form and size in a special setup on a Thompson surface grinder.

It will be noted that the rotor shaft is held securely in place by a flat sided hole broached in the center. After the shafts have been assembled with an interference fit, the rotor and shaft assembly is balanced dynamically on a Gisholt Dynetric balancing machine which permits of an accuracy of 0.4 oz. in.

As an example of large volume machining for water pumps, we have selected the routing of the water pump body which is made for one of the large engine builders at a rate exceeding 500 assemblies per day. This work is done in a self-contained department as mentioned earlier. It is equipped with specialized machine tools and features many single-purpose machine setups which remain undisturbed for long periods of time.

The housing for this particular water pump is made up of two separate castings. Accordingly, we also show the routing for the water pump cradle which mates with the body mentioned above. The bushing bore and the pilots at both ends of the cradle are

(*Turn to page* 112, *please*)

Factory Routing Supercharger Drive Gear

OPERATION AND EQUIPMENT

Normalize.

Chuck on OD in form jaws. Face side of rim, counterbore 3⅝ diam. face bottom, chamfer—**No. 4 Warner & Swasey turret lathe.**

Chuck in counterbore, face side of rim, turn OD to 4.215-0.003, chamfer both sides, bore 1.275-0.002, counterbore 3⅝ diam. to 0.721-0.006 depth, face bottom and chamfer—**#4 Warner & Swasey turret lathe.**

Heat treat.

Surface grind sides to 1½ width—**Blanchard surface grinder.**

Grind OD—**Norton external grinder.**

Mount in pot fixture, grind face to 15/32 diam. Reverse in pot fixture and grind opposite face. Mount in pot fixture and grind hole to size—**Heald internal grinder.**

Mount on flange nut arbor between center. True up one side of rim, reverse in centers, true up other side.

Cut teeth 2 at a time—**Fellows gear shaper.**

Shave teeth—**Red Ring shaving machine.**

Check for noise—**Red Ring gear speeder.**

Drill 4 0.375 holes to 11/32. Burr 4 holes—**Avey two-spindle drill press.**

Tooling Possibilities of Impregnated

By John Delmonte
Technical Director
Plastics Institute

Physical Properties of Plaster of Paris

	Physical Properties	
	Casting Plaster of Paris—Dry	Furane Resin Impregnated Plaster of Paris
Specific Gravity (dry)	1.14	1.65
Specific Gravity (wet)	1.60	....
Ultimate Compressive Strength	1800-2000 psi	8000-9000 psi
Flexural Strength	500-700 psi	2500-3500 psi
Impact Strength—Charpy ft. lbs/in.	.2 to .4	1.2 to 1.4
Surface Hardness—Barco indenter	too low	30
Shrinkage	negligible	negligible
Water Absorption—ASTM—24 hours	26%	under 2%
Max. Continuous Temperature (no loss of strength)	120 F.	180 F.
Effects of Acids, Alkalies	pronounced	very small
Thermal Expansion Coefficient	....	.000022

THE impregnation of plaster of Paris forms and patterns with synthetic resins, particularly those of the furane resin series, gives every indication of influencing considerably the tooling requirements of the automotive and aviation industries. Plaster of Paris forms are completely resinified through a simple impregnation process and rendered suitable to much more mechanical abuse. Resistant to chipping or breaking, impregnated plaster forms show promise in applications to hydropress work in forming sheet metal, and because of the highly polished surface which can be developed, they can be used as stretch press dies. Much of the tooling formerly prepared in cast metals for the automobile industry can now be safely considered in properly treated plaster.

Physical properties are comparable to those of cast liquid resins, with which automotive and aviation industries had such a wide working acquaintance during the war, with one notable exception—furane resin-impregnated plaster of Paris forms do not shrink, either at the time of curing or during service. At long last a dimensionally stable form has been achieved and this will influence greatly the manufacture of drill blocks and jigs, check patterns, and the preparation of master mock-ups for contoured surfaces.

The improvements in resin impregnated plaster forms are not limited to physical properties alone, inasmuch as there is a substantial gain in temperature resistance as well. Automotive foundry men will recall the poor performance of plaster of Paris when raised to elevated temperatures; its tendency to calcine and deteriorate as the water of crystallization is removed. Resin impregnated plaster, however, is much stronger and more resistant to higher temperatures. In the foun-

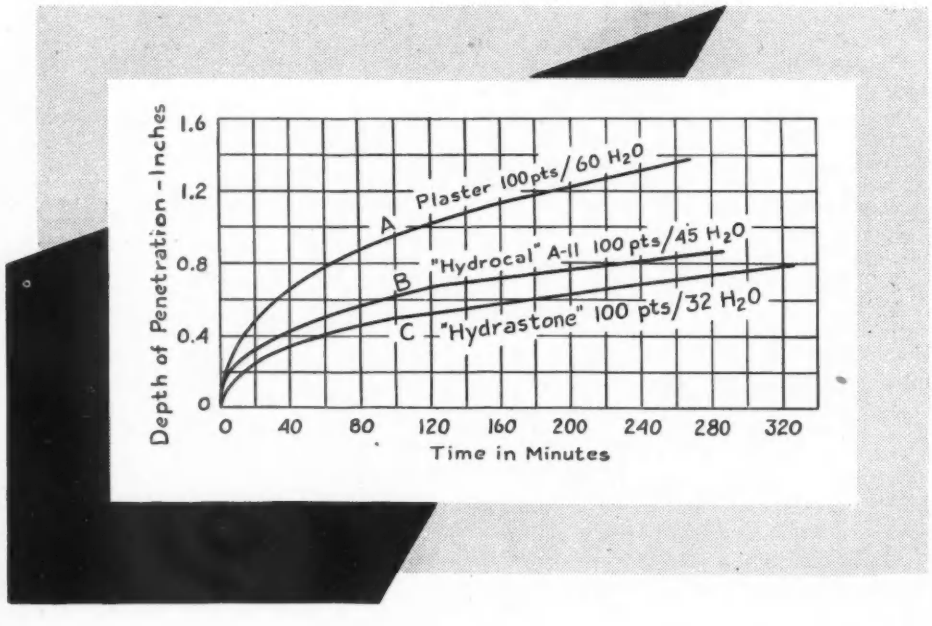


Fig. 1 (Left)—Diffusion of furane resin (2 to 3 centipoises viscosity) into dry plaster of Paris castings.

Fig. 4 (Right—Bottom of facing page)—Typical cycle of cure of plaster of Paris impregnated with furane resin XP.

of Plaster of Paris *with* Synthetic Resins

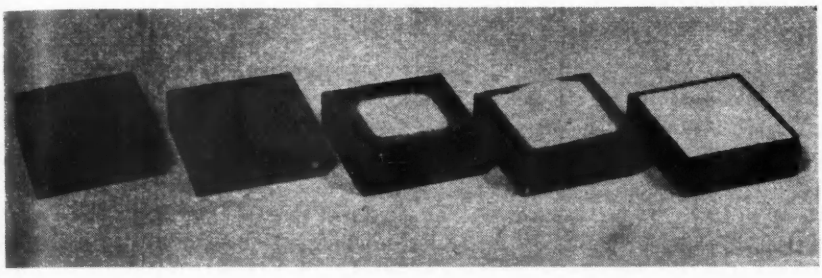
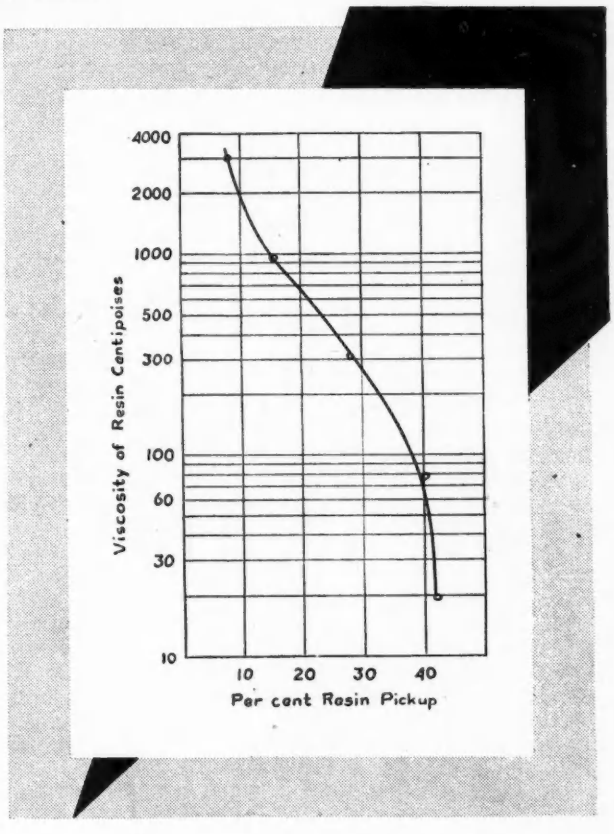


Fig. 2 (Left)—Different degrees of penetration of furane resin XP into plaster of Paris.

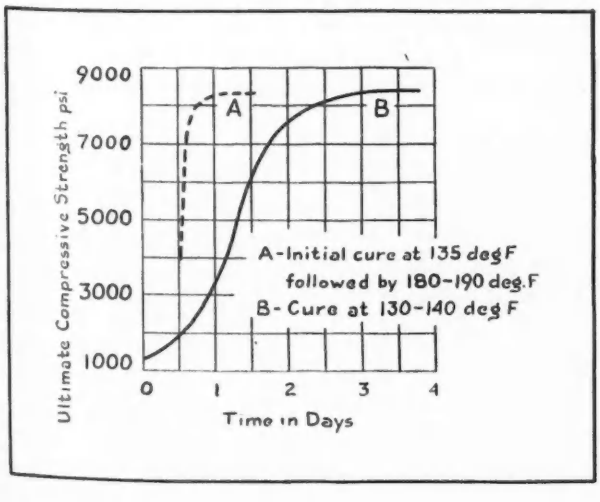
Fig. 3 (Below)—Impregnation of dry plaster of Paris with liquid resin XR at atmospheric pressure and room temperature.



dry, match plates and core boxes could well be considered in these materials. Unlike poured liquid plastics, plaster has a stabilizing effect upon the impregnated resin and retention of good strength at high temperatures is apparent. Further, improvements are apparent in chemical resistance as electroplating of the plaster forms is now possible, as well as excellent resistance to water and chemicals. The plaster department of automotive companies have shown considerable interest in these new developments which will vastly improve the role of plaster in retooling.

One has only to work with plaster of Paris to recognize the many advantages it possesses from a fabrication point of view. A 100-pound package of material, costing a total of $1.00, has a price advantage against which present plastics cannot begin to compete. When combined with approximately 60 pounds of water, the plaster will go a long way toward the preparation and casting of many useful objects. No baking or cure periods are required, and generally about 60 minutes after pouring (it sets in 20 to 30 minutes) it may be worked, carved or fabricated to various designs, if the mold has not already accomplished this. The finest details may, of course, be picked up from the mold, though if it is desired to work with the freshly poured "green" plaster, it may be cut easily with special tools or with the aid of templates to reproduce accurate contours. Considerable quantities of the materials are employed for patterns and mock-ups.

(*Turn to page 87, please*)



Injection

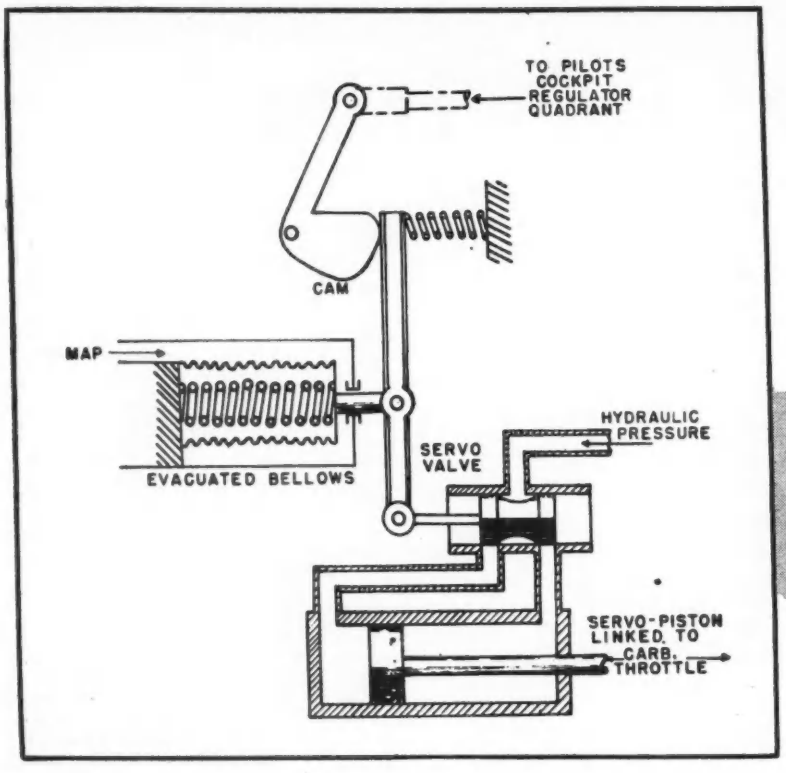


Fig. 1—Diagram of manifold pressure automatic regulator.

THAT water injection into the inlet manifold or cylinders tends to suppress detonation and permits higher effective pressures and greater specific outputs has been known since the early days of the internal combustion engine. At a comparatively early period in automobile history numerous attachments were on the market for supplying either water vapor or steam to the cylinders while the engine was running, and were generally claimed to ensure smoother engine operation (freedom from knock) and to prevent the formation of carbon deposits in the combustion chambers. Such water-injection equipment, however, did not become standard factory equipment on motor vehicles.

The effects of water injection and injection of other knock-suppressing fluids on the performance of aircraft engines have been under investigation for more than a decade, but particularly during the war period. That water when injected into the engine cylinders suppresses knock is due chiefly to the fact that its latent heat, or heat of vaporization, is abstracted from the combustible charge, which is thus kept cooler during the period immediately preceding normal ignition, so that spontaneous ignition or detonation of a portion of the charge is prevented. Alcohol has a much higher heat of vaporization than water, and therefore would be expected to be more effective than water as a detonation suppresser. Consequently, investigations of anti-detonating fluids for aircraft engines have been carried out with water and with ethyl and methyl alcohol (ethanol and methanol). As a rule, alcohol solutions have been used preponderantly, or alcohol-water mixtures, as they are generally called in this connection.

In this country the Wright Aeronautical Corp. has

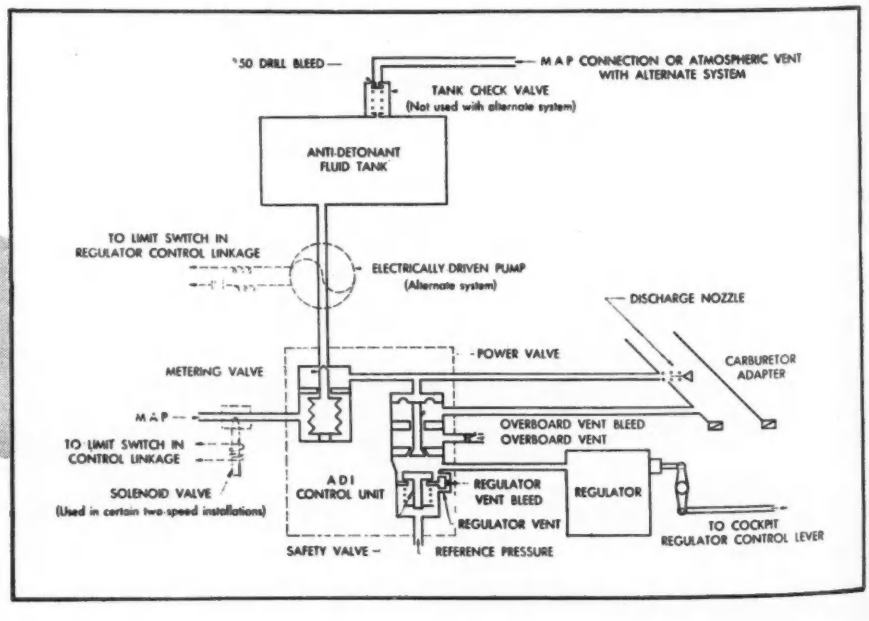


Fig. 2—Diagram of water-injection system.

# of Anti-Detonating Fluids in Aircraft Engines

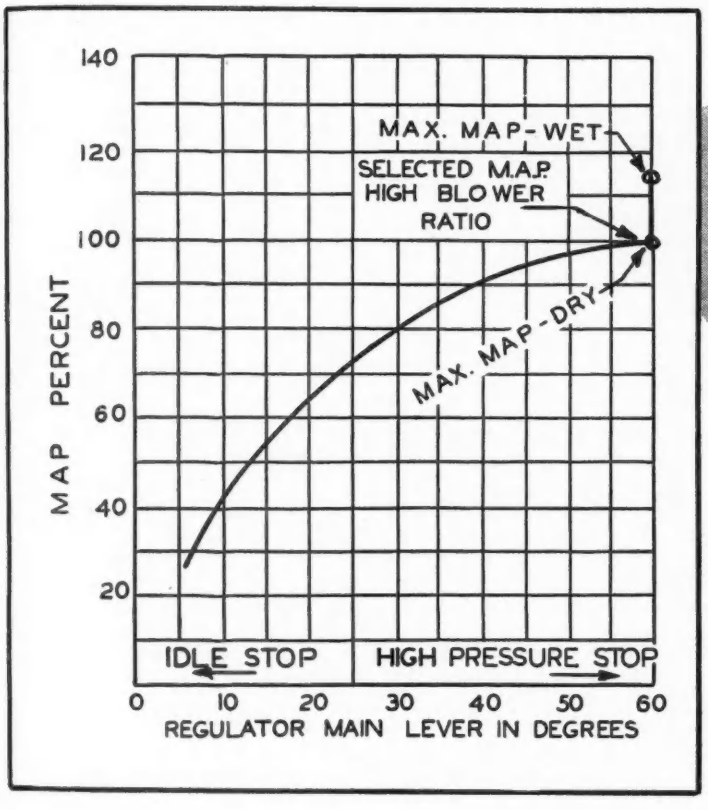


Fig. 3—Variation of manifold pressure with travel of automatic boost-control lever.

been particularly active in the study of the effects of water and alcohol-water injection in aircraft engines, and a paper on the subject was presented at the recent Fuels and Lubricants Meeting of the SAE in Los Angeles by M. R. Rowe and G. T. Ladd of that corporation. The subject has been under investigation also in Germany, and a report on German Power Boosting Systems for Aircraft Engines has been made available to us through the courtesy of the British Ministry of Aircraft Production. The following discussion of the subject is based on these two papers, all of the illustrations being from the paper by Messrs. Rowe and Ladd. It may be pointed out here that the German experiments were conducted not only with water, alcohol, and alcohol solutions, but also with nitrous oxide (laughing gas). The latter was carried on the plane under pressure, in the liquefied state, and was injected into the supercharger.

Wright Aeronautical Corp. in 1942 decided to develop water-injection equipment for use on aircraft engines. To make such a system completely automatic it is necessary to include an automatic manifold-pressure regulator to act as an engine-power control, or a turbo-supercharger regulator in the case of turbo-charged engines. The manifold-pressure regulator controls the manifold pressure by opening or closing the carburetor throttles. By means of a cockpit control lever the manifold pressure can be held at any desired value. The regulator assembly, of which a schematic drawing is shown in Fig 1,

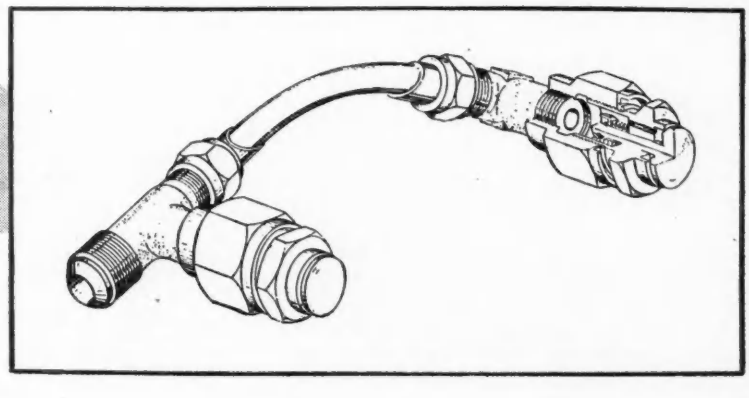


Fig. 4—Cutaway view of discharge valve.

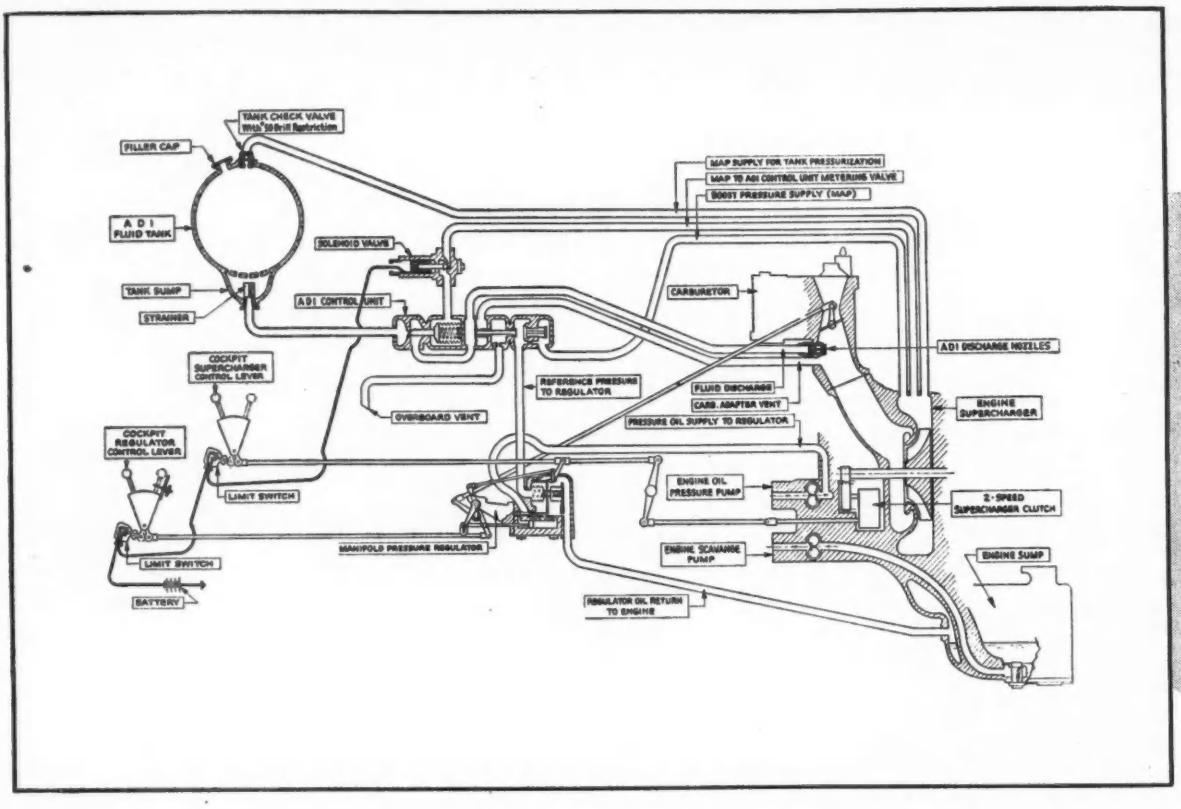


Fig. 5—Schematic diagram of Wright A.D.I. system.

consists of a cam, bellows, servo valve and piston, which act to open or close the throttles in response to changes in manifold pressure.

Schematic illustrations of the parts specially designed for the system, viz., the fluid meter, the power valve, and the altitude safety valve, together with the parts necessary to complete the system—the carburetor, water tank, and regulator—are shown in Fig. 2. The fluid meter controls the flow of fluid by means of a needle valve that is actuated by evacuated calibrated bellows sensitive to the manifold pressure. The cockpit control lever generally is provided with stops which limit the normal operating power of the engine. Beyond the normal stop the manifold pressure is sufficient to operate the automatic control system. The bellows is calibrated to open the metering valve at a definite pressure, thereby allowing anti-detonant fluid to be injected into the engine through the carburetor adapter. Fluid is delivered to the fluid meter from either a manifold pressurized tank or from a motor-driven water pump. In the design of this pump special pains were taken to prevent electrolytic action due to the use of dissimilar metals, the steel parts of the standard pump being replaced by non-ferrous metal parts and carbon vanes.

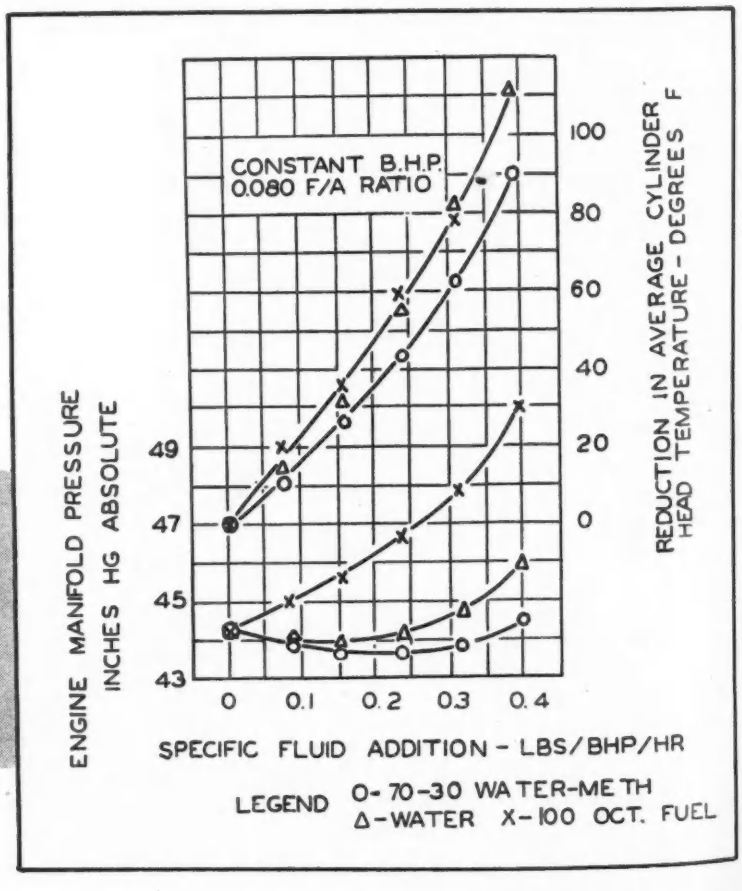


Fig. 6—Effect of anti-detonant-injection rate on cylinder-head temperature and manifold pressure (Wright Cyclone engine.)

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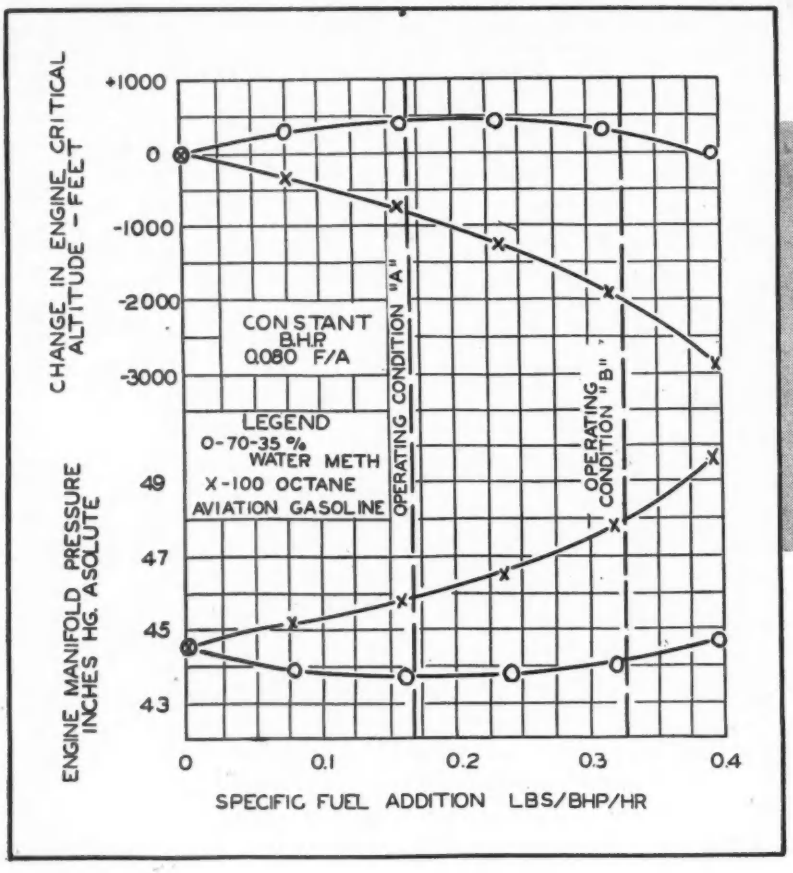

Fig. 7—Effect of fluid injection rate on engine critical altitude (Wright Cyclone engine).

fluid from and admission of air to the fluid discharge line will destroy the pressure differential. This allows the bleed passage to close, and the regulator will then operate at normal manifold pressures.

The safety valve governs the regulator control drop for emergency power. It is set for the maximum pressure drop desired across the regulator vent, and limits the drop by relieving the pressure into the regu-

(*Turn to page* 76, *please*)

The power valve is opened by the pressure of the anti-detonant fluid when that fluid is admitted to it. When the bleed passage is opened it vents off a controlled regulator pressure. The regulator tends to restore the pressure, and in doing so increases the manifold pressure and the engine output. Fig. 3, which applies to a Cyclone engine installation, is a plot of the proportional increase in manifold pressure with travel of the regulator main lever. It will be noticed that at the right-hand end of the curve two manifold pressures are indicated. The lower value is the maximum pressure permissible without water injection, In normal flight, when there is no need for internal cooling, the manifold pressure is not sufficiently high to open the fluid-meter valve, and both sides of the actuating diaphragm of the power valve are then subjected to the same pressure. Escape of

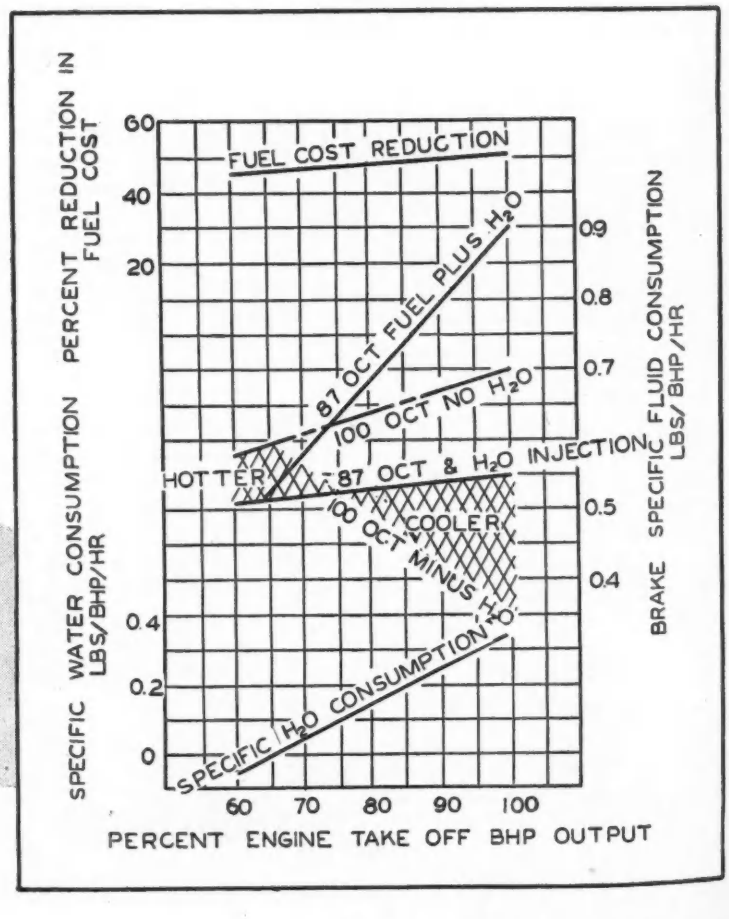

Fig. 8—Fluid consumption of engine with 87-octane fuel and water.

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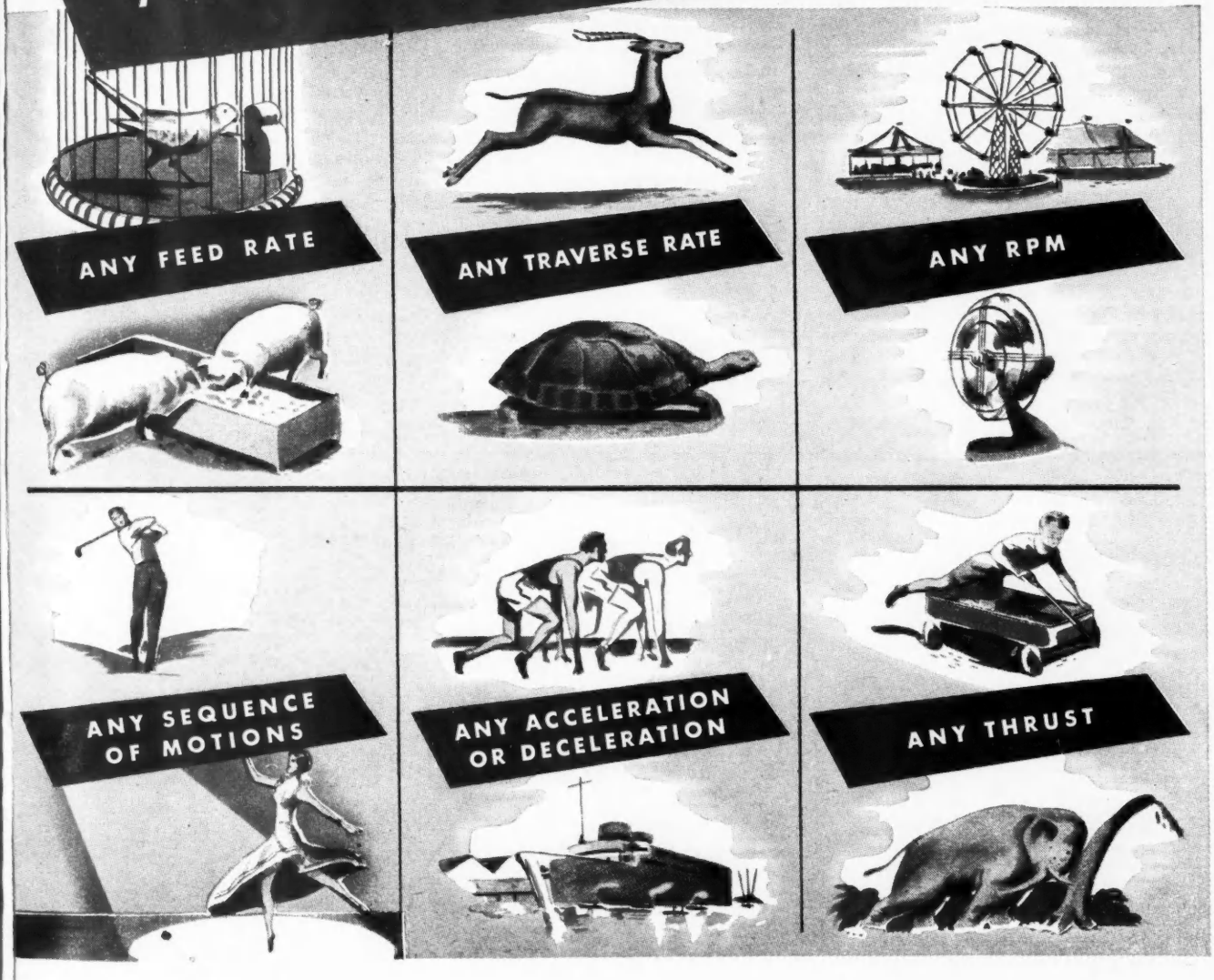

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Truck Registrations Gain 114,000

by Marcus Ainsworth

THE number of motor vehicles registered in the United States during the year ending Dec. 31, 1945, will be less by only 33 hundredths of one per cent approximately than the number registered during 1944. In number of units that means a net loss of 96,601 cars, trucks, buses and taxicabs. Car, truck, bus and taxicab registrations combined, it is expected, will total 29,843,627 in 1945, against 29,940,228 in 1944. This almost negligible decrease is remarkable in view of the fact that practically no passenger cars have been produced during the past four years and only 438,477 trucks have been turned out for civilian use since the beginning of the war and up through September of this year. Once again it has been most forcibly illustrated that there is more life in "the old grey mare" than was dreamed of before the war. However, while due credit for design, materials and workmanship must be given to the manufacturers, much must be given to the service men of the industry who have kept our cars, trucks and buses on the road despite the most serious handicaps.

At the end of this year there will have been registered during the preceding 12 months very close to 25,123,386 passenger cars and taxicabs alone as compared with 25,323,046 registered during 1944, a decline of only 199,660 units or eight-tenths of one per cent. Trucks will show a gain of approximately 114,000 units, from 4,517,083 in 1944 to an expected 4,631,011 by the end of 1945. Buses will have dropped from slightly over 100,000 to about 89,000.

These registration statistics resul from the annual survey conducted b AUTOMOTIVE AND AVIATION INDUSTRIES Forty-two states cooperated by furnishing their latest available data (which in most cases was that of Sept. 30) an their estimates for the remainder o the calendar or fiscal year. Past experience with the data obtained in thi annual survey which has been conducted for many years, indicates tha the estimated totals are usually within one per cent or less of the final returns

On the basis of the returns this yea the indications are that there will b increases in registrations in 26 state ranging from an increase of 7.47 pe cent in Delaware down to the low o 0.15 per cent in Alabama. The District of Columbia will show the greatest decline with an indicated drop o 9.69 per cent. It will be followe

(*Turn to page* 108, *please*)

Forecast of 1945 Motor Vehicle Registrations

STATE	Passenger Cars		Trucks		Buses		Total Motor Vehicles		Per Cent Change
	1945	1944	1945	1944	1945	1944	1945	1944	
Alabama	278,493	282,438	72,141	67,723	1,955	1,876	325,589	352,037	+0.15
Arizona	108,000	109,523	26,500	27,211	450	497	134,950	137,231	−1.67
Arkansas	191,000	190,156	76,500	74,459	1,110	939	268,610	265,554	+1.15
California	2,361,122	2,321,500	358,140	327,375	.....	.....	2,719,262	2,654,481	+2.44
Colorado	264,397	262,557	75,412	70,524	.....	1,446	339,809	334,527	+1.57
Connecticut	419,000	430,209	64,000	60,896	1,304	1,522	484,304	492,627	−1.69
Delaware	55,600	52,801	14,000	11,960	.....	.....	69,600	64,761	+7.47
District of Columbia	97,000	109,625	14,000	13,563	2,200	2,155	113,200	125,343	−9.69
Florida	425,000	404,630	98,000	88,053	3,500	2,980	526,500	495,663	+6.22
Georgia	420,000	424,492	103,500	97,553	4,400	4,465	527,900	526,690	+0.22
Idaho	112,000	111,797	36,000	35,533	250	233	148,250	147,563	+0.46
Illinois	1,487,732	1,518,629	222,128	216,930	.....	.....	1,709,860	1,735,559	−1.49
Indiana	818,000	805,539	147,200	137,252	8,000	7,557	973,200	950,348	+2.40
Iowa	586,000	595,542	101,400	98,373	.....	.....	687,400	693,915	−0.91
Kansas	469,352	476,852	124,059	121,819	.....	.....	593,411	598,671	−0.88
Kentucky	361,800	355,534	80,000	76,603	.....	.....	441,800	432,137	+2.23
Louisiana	321,500	324,906	73,000	72,015	850	828	395,350	397,749	−0.61
Maine	148,400	146,227	48,000	44,527	500	491	196,900	191,245	+2.95
Maryland	395,300	398,650	58,500	61,672	1,400	1,432	455,200	461,754	−1.42
Massachusetts	743,000	719,215	109,000	103,606	5,425	4,983	857,425	827,804	+3.57
Michigan	1,309,369	1,339,000	122,315	158,174	.....	.....	1,431,684	1,497,174	−4.38
Minnesota	629,000	644,237	114,100	113,666	375	335	743,475	758,238	−1.95
Mississippi	180,000	182,573	54,000	55,367	1,000	919	235,000	238,859	−1.62
Missouri	683,279	688,276	150,000	143,867	.....	3,681	833,279	835,824	−0.31
Montana	108,125	110,617	47,650	45,950	.....	780	155,775	157,347	−1.00
Nebraska	333,500	327,080	73,000	72,544	600	511	407,100	400,135	+1.74
Nevada	36,500	37,106	10,000	9,520	.....	.....	46,500	46,626	−0.28
New Hampshire	92,000	88,703	27,305	27,240	.....	.....	119,305	115,943	+2.89
New Jersey	839,502	843,168	141,275	138,937	8,960	9,051	989,737	991,156	−0.15
New Mexico	86,167	82,222	28,707	27,826	1,450	1,448	116,324	111,496	+4.33
New York	1,943,673	1,936,418	294,321	282,091	8,922	8,817	2,246,916	2,227,326	+0.13
North Carolina	497,605	495,145	98,279	93,063	2,882	2,570	598,766	590,778	+1.35
North Dakota	132,000	133,434	49,614	46,946	154	151	181,768	180,531	+0.68
Ohio	1,526,875	1,696,528	143,000	144,484	3,200	3,176	1,673,075	1,844,188	−9.28
Oklahoma	391,800	390,488	105,000	102,383	2,000	3,697	498,800	496,568	+0.44
Oregon	330,000	331,641	80,000	77,773	1,200	1,219	411,200	410,633	+0.13
Pennsylvania	1,654,183	1,643,154	277,670	276,072	8,572	8,309	1,940,425	1,927,535	+0.66
Rhode Island	154,266	152,441	22,250	20,800	704	673	177,220	173,914	+1.90
South Carolina	271,737	279,378	51,367	45,701	2,613	2,600	325,717	327,679	−0.60
South Dakota	141,000	142,678	37,200	35,590	200	183	178,400	178,451	−0.03
Tennessee	375,000	367,787	76,000	73,650	4,500	4,263	455,500	445,700	+2.19
Texas	1,250,000	1,264,805	280,000	286,669	1,850	1,806	1,531,850	1,553,280	−1.38
Utah	125,359	126,929	26,000	25,836	293	567	151,652	153,332	−1.10
Vermont	76,000	73,679	11,000	10,806	165	150	87,165	84,835	+2.74
Virginia	440,000	431,481	93,978	82,912	2,746	2,717	536,724	517,110	+3.79
Washington	500,000	505,153	97,000	96,168	2,000	1,960	599,000	603,281	−0.71
West Virginia	210,750	218,118	60,000	55,743	1,200	1,058	271,950	274,919	−1.08
Wisconsin	680,000	687,717	137,000	139,186	2,300	2,268	819,300	829,171	−1.20
Wyoming	63,000	62,068	21,500	20,472	.....	.....	84,500	82,540	+2.37
U. S. Total	25,123,386	25,323,046	4,631,011	4,517,083	89,230	100,099	29,843,627	29,940,228	−0.33

(Advertisement)

The CONE AUTOMATIC MACHINE COMPANY

sees many

GOOD THINGS AHEAD

It is reported that . . . . . .

A technical magazine states that the war-developed arc-oxygen electrode will cut quarter-inch steel plate at the rate of a foot per second while under 40 feet of water. *Metal and Thermit Corp.*

get ready with CONE for tomorrow

It is estimated that within a few years 80% of the coal mined underground will be removed from the mines on conveyor belts instead of in cars. *Scientific American.*

get ready with CONE for tomorrow

The PV-3 helicopter has a long fuselage with a rotor on each end and carries twelve persons. It is being tested by the Coast Guard and Navy. *Popular Science.*

get ready with CONE for tomorrow

A new cement, for use in concrete flooring, is said to drive away insects, kill bacteria, and prevent the formation of molds. It also dissipates static electricity. *H. H. Robertson Co., Pittsburgh.*

get ready with CONE for tomorrow

An appliance manufacturer announces an electric washing machine that can also, by the use of attachments, wash dishes, peel potatoes, churn butter, and freeze ice cream. *Hurley Machine Division Elec. Household Utilities.*

get ready with CONE for tomorrow

A new gasoline-powered lawn mower resembles a floor scrubbing machine. It is mounted on four wheels and uses a rotary knife revolving at 3,000 r.p.m. *Whirlwind Lawn Mower Corp., Milwaukee.*

get ready with CONE for tomorrow

The manufacturer of the jet engine used in the P-80 Shooting Star prophesies that all transcontinental planes will be jet-propelled within five years. *General Electric.*

One of the war devices that may survive to help the motorist is the tire gauge that registers on the dash, developed for the Army's amphibious "duck." *GMC Truck and Coach Div.*

get ready with CONE for tomorrow

A magnetic survey of the state of Florida shows large areas in the southern part that are favorable for the occurrence of petroleum. *U. S. Dept. of Mines.*

get ready with CONE for tomorrow

Meals are being served in the Naval Air Transport Service that are pre-cooked, packed in a covered paper plate and frozen. On the plane they are thawed and heated in a special oven. *Maxon Sky Plate, W. L. Maxon Corp., 460 W. 34th St., New York.*

Air conditioned trolley cars are being introduced in a Southern city. This is said to be the first use of such equipment in city vehicle transportation. *Atlanta, Ga.-Pullman-Standard.*

get ready with CONE for tomorrow

A new household electric light switch can be set for delayed action up to three minutes. *T. J. Mudon Co., 1240 Merchandise Mart, Chicago.*

get ready with CONE for tomorrow

Rubber V-belts molded around a steel cable have been developed to replace chain drive on Army motorcycles. *Goodyear, Akron 16, Ohio, Whizzer Motor Co., Los Angeles.*

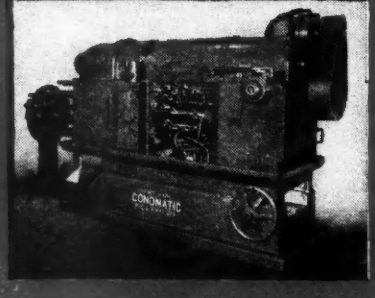
get ready with CONE for tomorrow

Even the common wire nail has been improved. The new type has a notch in place of the point and is claimed to be non-splitting. *E. S. Gair, Snyder, New York, inventor.*

15 operations in 12 seconds

The 15 operations that form this washing-machine part of B-1112 steel, including rolling the oil groove* in the outside diameter, are performed by the 8-Spindle Conomatic in 12 seconds.

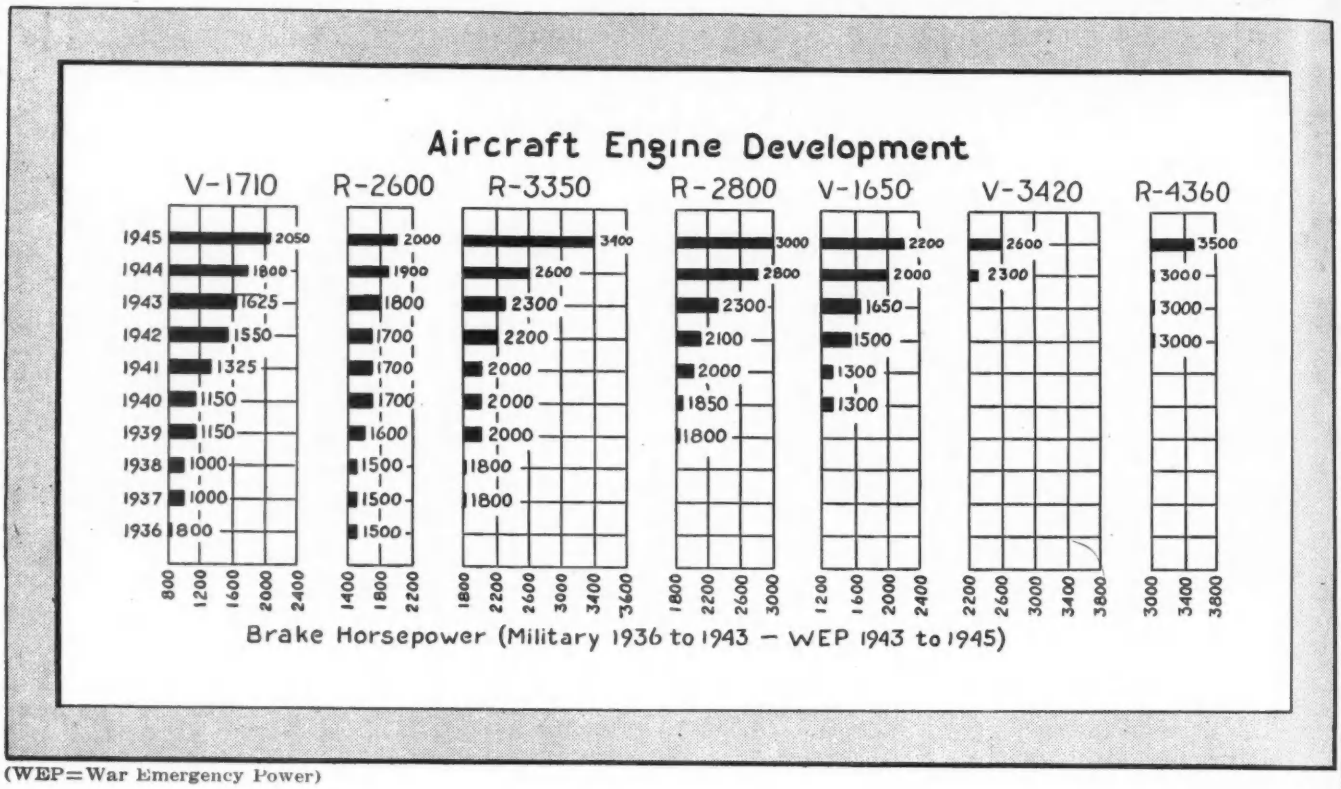
*Write to Cone for particulars



CONE

AUTOMATIC MACHINE CO., INC. ★ WINDSOR, VERMONT, U.S.A.

24



(WEP=War Emergency Power)

Aircraft Engine Progress

STUDY of this record of aircraft engine development with respect to increase in brake horsepower reveals that it starts at approximately the time when the American aircraft engine industry was just beginning to exhibit increased energy following the depression in engine advancement after the first World War and the years immediately following 1929 when commercial interests were paramount. The record, however, indicates that these years were comparatively well used even though the advance had been slow and discouraging at times. At the end of the first World War aircraft engine designers looked ahead to the high output of 500 horsepower as the ultimate that could be used in airplanes or could be built to operate satisfactorily. As late as 1928 engine test laboratories were built with the idea in mind that it would require at least 20 years to attain the then unheard-of rating of 1500 horsepower, yet the record shows that in 1936, just eight years later, an engine rated at 1500 horsepower did actually exist and was being tested.

By Col. Donald J. Kiern

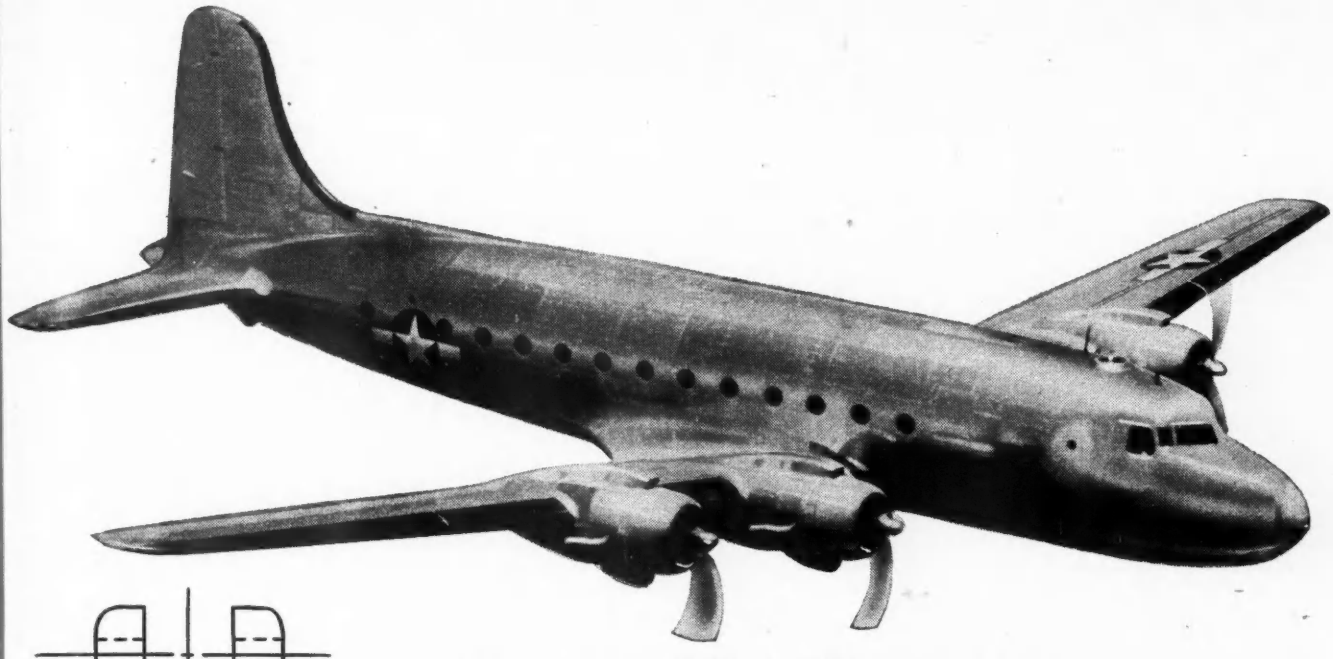
Chief, Power Plant Laboratory,
Engineering Division,
Air Technical Service Command

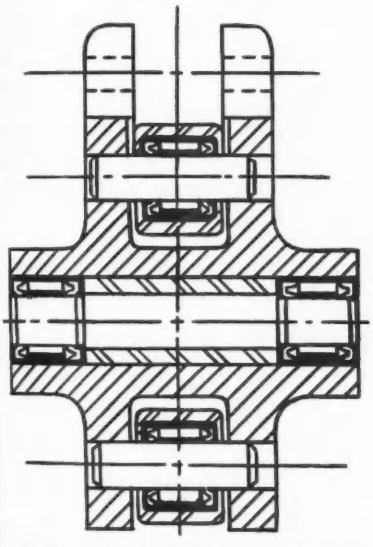
During this period the advancement in horsepower can be credited to the work of the aircraft engine design engineer or, perhaps, to the training and development of design engineers trained to think along peculiar lines necessary to aircraft engine design. In this field of design the component parts of an aircraft engine, even as many as 16,000 for a single engine, must be designed to attain their strength through good design and use of materials since the last resort of designers of other machines, when all known formulas failed, would be to add enough material by means of a fudge factor to insure strength. However, this method cannot be used in aircraft engine design since weight as well as strength is an important factor in the final utilization of the engine.

For the period following the year 1936 and the first 1500 horsepower engine, and until the start of World War II, engine horsepower increase can be credited to a very large extent to the increase in fuel quality leading to the standardization of 100-octane fuel with its challenge to the engine designer to obtain full advantage of the additional potential power without marked increase in engine size or weight. It was during this period also that the designer learned to make greater use of improved alloys and bearing materials to match the increased performance permitted by the better fuel.

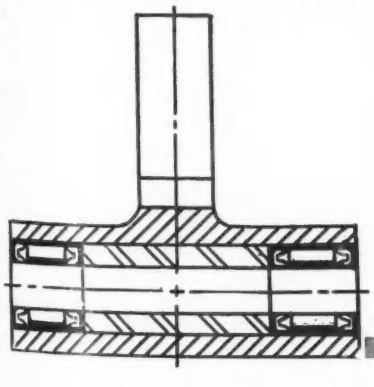
The war period, of course, accelerated and intensified the trend to higher horsepowers, as shown by the chart, but until water injection was adopted, the ques-

(*Turn to page* 66, *please*)





Four Torrington Needle Bearings are shown in the above cross-section drawing of the lever assembly of a landing gear 4-way valve, as used in the Douglas DC-4 Skymaster. Below is a cross-section view of the cam assembly of the same valve, in which two Needle Bearings are used. Torrington Needle Bearings effect savings in space and weight, yet maintain dependable, anti-friction performance.



Douglas DC-4 Skymaster Hydraulic Control Operates Smoothly on Needle Bearings

In the Douglas C-54 (DC-4) Skymaster, as in many other types of aircraft, where savings in space and weight mean *increased payload,* Torrington Needle Bearings play a vitally important part. That is only logical, because Needle Bearings are compact and light in weight, and yet do not sacrifice any of the equally important qualities of high load capacity, dependability, long service life or ease of operation under severe conditions.

Regarding the application of Torrington Needle Bearings in the lever and cam assemblies of a 4-way valve of the Skymaster's landing gear, Douglas engineers have this to say, "A saving in both weight and space were effected where the anti-friction qualities and high load capacity of the Needle Bearings were required to accomplish a smooth action of this hydraulic control."

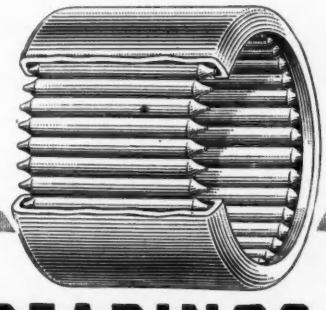
These plus features, combined with low initial cost and ease of installation and lubrication, tell you why, in the aeronautical, automotive and related industries, Torrington Needle Bearings are used in a wide range of applications. Write for our Catalog 32 for complete Needle Bearing information.

THE TORRINGTON COMPANY

Established 1866

TORRINGTON, CONN. • SOUTH BEND 21, IND.

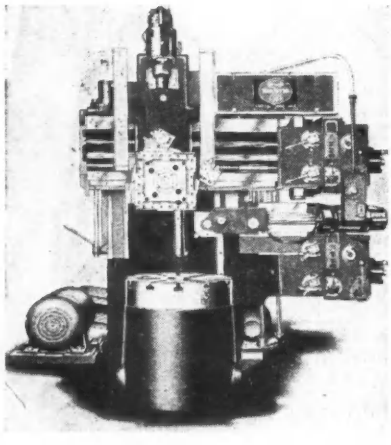
New York Boston Philadelphia Cleveland Detroit Seattle Chicago San Francisco Los Angeles Toronto London, England



TORRINGTON NEEDLE BEARINGS

New Production Equipment

THE Bullard Co., Bridgeport, Conn., has brought out the Man-Au-Trol vertical turret lathe in two sizes, 30 in. and 36 in., and will produce the machine in 42-in., 54-in., 64-in. and 74-in. sizes when manufacturing conditions permit. The Man-Au-Trol vertical turret lathe is fundamentally a vertical turret lathe embodying new principles of control and operation. The machine itself is built around the Bullard Cut Master and, therefore, retains the inherent characteristics of this machine. However, the machine may be controlled either entirely by the operator, or entirely by Man-Au-Trol (Bullard's new control device) applied to each head of the machine. The change from automatic to manual operation is accomplished by means of a single lever attached to the control mechanism.



Bullard Man-Au-Trol vertical turret lathe

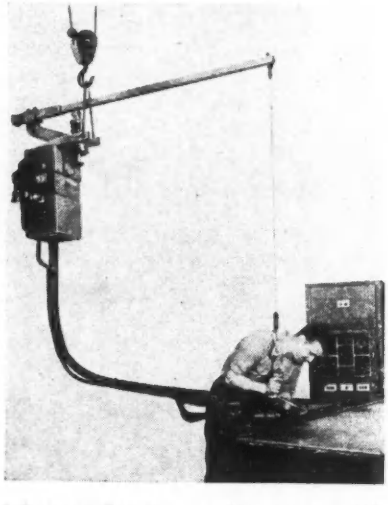
When only one or two pieces are to be machined, the control lever may be placed in the manual position. The pieces may then be machined and the machine itself controlled by the operator in exactly the same way as other vertical turret lathes. Various speeds and feeds can be easily obtained by simply moving manually-operated levers to their proper positions. Power traverse in any direction and through any required distance is accomplished by engaging the control lever. The turret may be indexed at will. The heads may be accurately positioned by means of the customary hand cranks and micrometer dials. In other words, the adition of Man-Au-Trol in no way detracts in the least from the manual control and operation of the machine.

If approximately ten or more pieces are to be machined, the Man-Au-Trol may be set to control the machine throughout its entire cycle of operation. Man-Au-Trol will control every sequence of functions of which the machine is inherently capable. To be explicit, Man-Au-Trol controls the following functions: Direction of feed on each head—up, down, in or out; rate of feed of each head—any one of 16 feeds may be selected for each cut on each head, and may be automatically changed in the middle of a cut; direction of power traverse on each head—up, down, in or out; indexing of turret on each head—the turrets may be indexed at any time during the operating cycle of the machine, provided the tool is not in cut, and may be indexed as many times as desired; and spindle speeds—spindle speeds may be changed automatically at any time during the operation of the machine.

A COMPLETE new line of overhead type portable spot welding units has been announced by Sciaky Bros., Chicago, Ill. Both pneumatic and hydraulic systems are available with transformer ratings of 50, 75 and 100 kva. A variety of standard gun styles in both alligator and "C" types are designed to fit nearly every application. Special emphasis is made on lightness in both gun and cable design. Spring type or pneumatic balancers are provided for easy positioning of the gun.

Transformers may be with or without tap switch. Electronic control units are available for control of welding sequence, current interruption and, where desired, electronic control of welding heat. Unit may be permanently suspended for production lines, or hung from any jib hoist, monorail, etc., for tack or structural welding on large assemblies.

The hydraulic system makes efficient use of water with special fast-acting booster and electro-valve. In case of leakage, the system is automatically refilled from same line supplying cooling water to transformer, cables and gun.

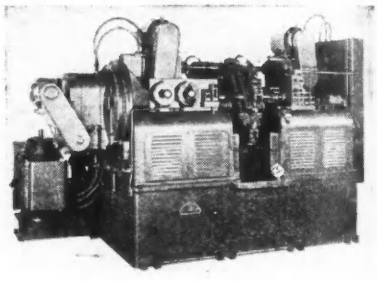


Sciaky overhead portable spot welding unit

SNYDER TOOL AND ENGINEERING CO., Detroit, Mich., has designed a special-purpose machine for boring, facing and tapping valve bodies of iron, bronze or aluminum in a wide variety of shapes and sizes.

The part is held in a fixture on a four-station trunion. The work-holding device locates and clamps through a two-jaw chuck actuated by two hydraulic cylinders for clamping and unclamping.

Side housings each contain two individually-driven and hydraulically fed tool spindles with brackets sliding on hardened and ground ways. Each spindle has a variable speed d-c motor



Snyder machine for boring, facing and tapping valve bodies

to obtain maximum efficiency in the tool diameters used. Spindles are adjustable for speed independently through electric rheostats. Hydraulic feed rates are adjustable for each individual slide.

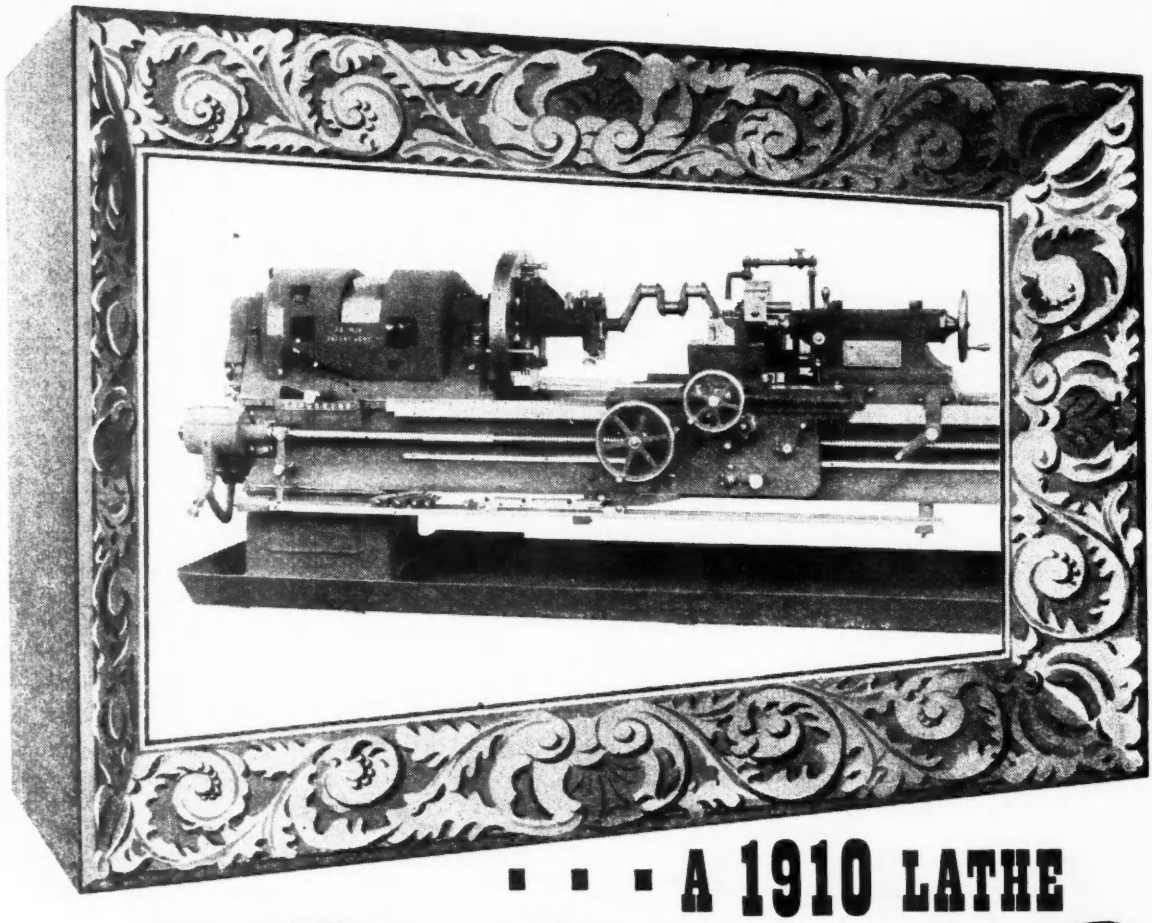
Tapping units are equipped with individual lead screw and quick-change pick-off gears for tool speed change. Lead screws for various pitch threads are easily exchanged.

Left-hand housing carries an indexing trunion positioning mechanism which is motor driven over a Geneva index wheel. The coolant tank and hydraulic unit and motor generator set for variable speed spindle motors are in the rear.

THE Van Norman Co., Springfield, Mass., offers a new No. 3 horizontal milling machine designed for a wide range of general purpose and production milling. Its table is 14 in. by 64 in., permitting the handling of heavy work. A large-diameter fly wheel mounted on the spindle inside the column, assures smooth, uniform application of power to the cutter. Among the new engineering and design features incorporated in the new miller are a new column and base casting which is broader and heavier with generous internal ribbing to assure rigid support for the heavy duty spindle transmission as well as the generously proportioned knee.

The rigid ram-type overarm has

(*Turn to page* 114, *please*)



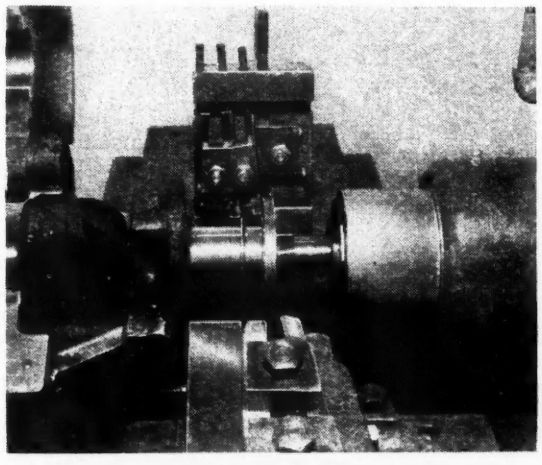
. . . A 1910 LATHE

for Today's Crankshaft Jobs?

● The "old timer" pictured above was mighty good for its day. On a crankshaft job one tool in a simple toolholder was then adequate. But feeds and speeds were unbelievably slow . . . rapid duplication of parts impossible. And skilled operators were essential.

Consider, in contrast, today's latest 2A or 3A Duomatic—Lodge and Shipley full automatic lathes. View at the right also shows a crankshaft job—with six tools cutting simultaneously. Dual tool slides—front and rear—operate singly or together, permit any combination of "in" or "out" facing cycles, turning, boring or forming, *without special attachments!* Unskilled operators produce large or small lots with equal facility.

If you have "antiques" or war-weary lathes call in L & S Engineers. A modern L & S Lathe can replace several of these out-worn tools—give you production, accuracy, and low costs never before possible.



Write on your company letterhead for detailed literature on the following: Engine, Tool Room, Automatic, Manufacturing, Oil Country Lathes.

THE LODGE & SHIPLEY MACHINE TOOL CO.

L & S LATHES

CINCINNATI 25, OHIO, U. S. A.

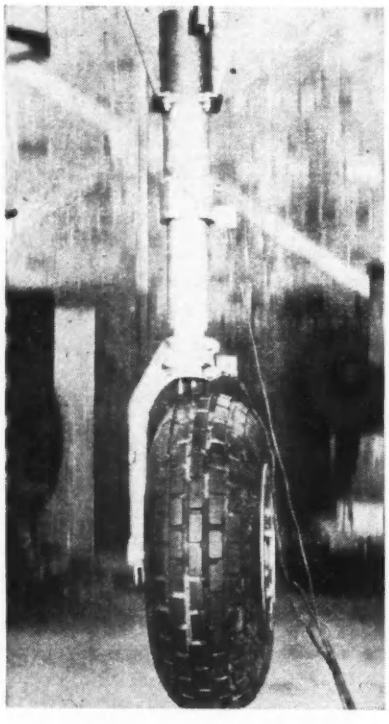
MACHINE TOOL DIVISION 3055 COLERAIN AVE. • SPECIAL PRODUCTS DIVISION 800 EVANS ST.

New Products for Aircraft

Improved Strut for Aircraft

The L.C.N. strut, a recent development of the L.C.N. Corp., Middletown, Ohio, employs air, in addition to oil, to absorb the shocks of landing and taxiing. It is designed to maintain its own air pressure and to return any oil which might leak out around the piston.

The air which performs a taxiing and landing service, and the oil for landing, are separate from each other. The sealing oil in the taxiing cylinder, as stated before, is automatically replenished when taking off and landing. The strut itself performs these functions of pumping its air and adjusting



L.C.N. strut in drop-testing machine

the pressure. The balance or equalizing chamber controls the pressure and volume of air in the taxiing chamber, and by its volumetric capacity adjusts it to a predetermined weight capacity.

The taxiing cylinder is so constructed that the air, which is harnessed, actually absorbs energy in landing and will not interfere with the smooth taxiing qualities of the plane. The strut is practically hollow in its entire length, except for the ram and ram tube, which takes care of the landing energy.

The fact that the oil in the L.C.N. strut is under an exceptionally high pressure at the moment of landing, heats the molecules and instantly thaws the oil fluid. Small ram diameters cause a higher resiliency of the oil; this assists in producing a lower gravity than the present-day struts, and harmonizes with the undisturbed resilient qualities of the air.

Plastic Battery Container

An all-plastic battery container, weighing less than ten pounds, which is being used to house the specially designed 12-volt storage battery used on the jet-propelled P-80 "Shooting Star," recently was made available for general aircraft use.

Fabricated of transparent "Lucite" methyl methacrylate resin, the container is easy to install and remove. It has good heat and acid resistance, according to the Electric Storage Battery Co., Philadelphia, Pa., the manufacturer. The plastic offers a 20 per cent reduction in weight compared with aluminum and rubber, the usual military aircraft container materials, and is sturdy enough to withstand any shocks incident to normal handling.

The complicated fabricating requires milling the plastic to an overall tolerance of plus or minus 1/32 in. to insure a tight fit in the plane, with some component parts held to a tolerance of plus or minus 0.001 in. Side rails, used for sliding the battery into place, are constructed separately and cemented to the sides of the transparent housing. The makers of the batteries report they are now working on the problem of molding the entire nine and three-quarter pound container in one piece.

Jack & Heintz to Make Aircraft Electric Motors

Jack & Heintz, Cleveland, Ohio, have entered the aircraft electric motor field with the introduction of the first of a group of new lightweight continuous duty geared electric motors. These units are being made available in sizes ranging upward from one hp. Although originally designed as aircraft pump motors, they are readily adaptable for many other similar applications in various sizes adequate to cover a wide field.

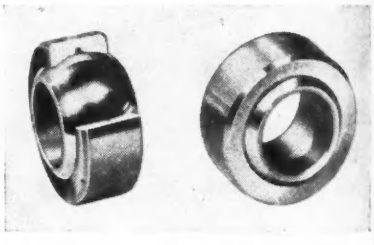
Jack & Heintz Model JH-13100 motor

The Model JH-13100 motor (illustrated), designed for 28-volt DC systems, is rated for continuous duty at three hp with a speed of 3800 rpm at the splined output shaft. This self-cooled unit, developed to operate efficiently at 40,000 ft altitude, weighs only 19½ lb and occupies a cylindrical space approximately 6 in. by 10½ in.

The electrical connector is AN type, the drive and mounting flange is standard AND 10001-D2, and the cradle support optionally employs the same mounting bolt hole spacing. Furnished with prelubricated precision ball bearings, the unit will operate efficiently in any mounted position.

Spherical Bearings

The Halfco spherical bearing, made by Halfco-Engineers, Los Angeles, Cal., is now off the critical material list and is available in any quantity to manufacturers of equipment or engines using self-aligning bearings or



Halfco spherical bearings

rod ends with self-aligning bearings installed.

The first two-piece self-aligning bearing to be produced, the Halfco spherical bearing, is made from a one-piece bronze outer race into which is pressure-inserted a hard-chrome plate steel ball. The Halfco spherical bearing can be used whenever alignment is costly or impossible to attain, or wherever rigidity is at a premium.

Pressurized Connectors

To meet the demands of higher altitude flying where pressurized cabins are required and for many other uses, improved pressurized receptacles in both Cannon "AN" and "K" standard connector types, and in "AN" sizes from 12S to 44 inclusive are offered by the Cannon Electric Development Co., Los Angeles, Cal. Inserts are spun-in the shell with a special sealing washer. However, the arrangements are limited to those carrying No. 20, 16 or 12 small contacts only at the present time.

Air leakage pressure tests for these fittings conform to Sec. F-6n of the

(*Turn to page* 112, *please*)

When Carpenter made Stainless COST LESS TO USE

The postwar kitchen your wife's been dreaming about probably will include a lot of Stainless Steel. Wisely, she knows that Stainless gives her kitchen equipment the gleam, the cleanliness and the long, rust-free life few metals can match.

The trend toward Stainless in kitchens has been on for many years now—ever since Carpenter pioneered Stainless that costs less to use. That egg beater is a good example of a utility item that can be made inexpensively with Carpenter uniform and ductile Stainless Strip. And hardware trim, refrigerator shelves, cutlery, nuts, bolts, etc., can be turned out faster, with fewer rejects, at lower costs with versatile Carpenter Stainless Steels.

There's an idea here that can well be applied to your new or redesigned products—whether they're for household or industrial applications. Make them better at lower cost with easy-working Carpenter Stainless Steels. The first step is to take advantage of the diversified experience of your nearby Carpenter representative. Call him in to talk over your specific problems today, or write us at the mill.

Thousands of designers and fabricators use our 98-page book "Working Data for Carpenter Stainless Steels" to obtain best results with Stainless. For your copy, jot a note on your company letterhead, indicating your title.

THE CARPENTER STEEL COMPANY, 103 W. BERN ST., READING, PA.

Carpenter STAINLESS STEELS

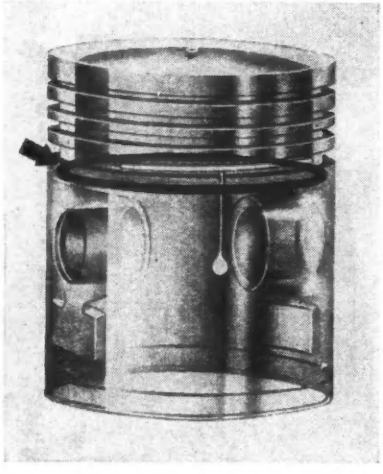
...for
Strength
Rigidity
Heat Resistance
Corrosion Resistance
Longer Product Life
Sales Appeal

BRANCHES AT
Chicago, Cincinnati, Cleveland, Detroit, Hartford, Indianapolis, New York, Philadelphia, Providence, St. Louis

New Products

Alloy Piston with Cast-In Steel Belt

An alloy piston girdled by a cast-in steel belt is now being manufactured by Thompson Products, Inc., Cleveland, Ohio, for original equipment and replacement applications. The belt, of a special alloy steel, circles the piston just above the pin bosses and is said to



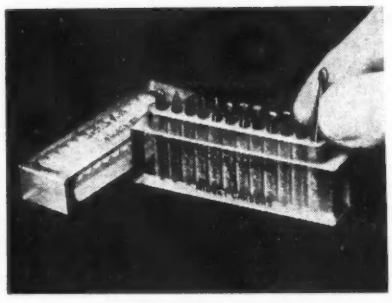
Thompson Steel-Belted piston

control the piston so that it expands at the same rate as the cast iron cylinder block, throughout the range of engine temperatures. Because of this feature the steel-belted piston may be fitted more closely than conventional alloy types without danger of scoring or seizing, the maker claims. The piston is well ribbed and re-inforced, but simply designed.

Rotary Files of Tungsten Carbide in Small Sizes

Rotary files of solid tungsten carbide are now being produced in extremely small sizes by Lincoln Park Industries, Lincoln Park, Mich. These tools, known as Midget Carburs, are furnished in sets for tool room, die shop, pattern shop and general production use. The set consists of 12 tools in assorted shapes contained in a plastic case.

In application, they serve as a replacement for hand files and mounted grinding wheels in innumerable operations requiring these tools. Their extreme hardness permits them to be used on practically any material, including hardened steel up to 65 Rockwell C. They are operated at speeds from 65,000 to 100,000 rpm. Sharp corners, forms and radii can always be maintained. On softer materials the same advantages are apparent, and in



Midget Carburs

addition their life is said to be at least 50 times that of steel files.

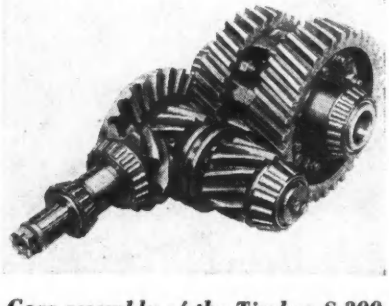
The twelve tools produced for the standard set, and which may be purchased individually if desired, are 1⅛ in overall with ⅛ in. diameter shanks.

New Timken Rear Axles

Two new 2-speed rear axles—the S-300 and U-300—are announced by the Timken-Detroit Axle Co., Detroit, Mich. The S-300 rear axle is intended for heavy-duty hauling on highways and city streets. Torque capacity is ample for modern high power engines. The U-300 rear axle is for off-the-highway operations, using the same engine torque, but where still greater load-carrying capacity is required.

The S-300 and U-300 2-speed series are companion axles to the S-200 and U-200 hypoid-helical double reduction drive single speed axles previously introduced by Timken. Both types of final drives, the double reduction single speed and the 2-speed double reduction are interchangeable with each other in the same axle housing.

The new S-300 and U-300 heavy-duty rear axles feature a new 2-speed hypoid-helical double reduction final drive. It provides two efficient gear ratios in one final drive. The first step in gear reduction is obtained through a large diameter hypoid bevel gear and pinion. The second step is selective between two sets of wide-faced helical spur gears—a "fast" and a "slow" helical reduction. Gears are of special alloy steel with teeth carburized and hardened. Gear ratios available are 6.53 high-8.53 low.



Gear assembly of the Timken S-300 and U-300 double reduction rear axles

A feature of these new heavy-duty 2-speed axles is the built-in Timken Easy Power Shift for vacuum or compressed actuation. This mechanism enables the driver to select the proper axle gear ratio—"fast" or "slow"—by means of a control on the dash. He may shift from "fast" to "slow" axle speed or "slow" to "fast" in a split second—without de-clutching. The Easy Power Shift controls the movement of a sliding clutch collar which engages one or the other of the two spur pinions. Final sliding of the clutch collar into engagement with "slow" or "fast" speed helical pinion is done by a spring which provides a cushioning effect. Correct spring pressure insures positive engagement with no undesirable shock loads on the gear teeth. The power for shifting axles ratios is furnished by a vacuum or compressed air power chamber front-mounted on the axle, operating through a bell crank inside the housing. All moving parts are enclosed and require no lubrication.

Axle housings in both axles are similar in design. The U-300 axle has larger housing sections for its greater load-carrying capacity.

Operators have a choice of two brakes—Timken "P" power brake or "DP" Dual Primary hydraulic brake.

Grease for Ball and Roller Bearing Motors

For dependable lubrication from 13 to 176 F at all speeds up to 3600 rpm and for horizontal or vertical operation, an improved grease for ball and roller bearing motors is announced by the Westinghouse Electric Corp.

Available in a new eight ounce nasal type tube, the grease is said to be stable, highly resistant to oxidation and to remain in a bearing for an indefinite period without drying out, caking or separating. The new tube is designed for easy and economical use. It has a large opening in the long nasal spout which fits into a ⅛-in. pipe coupling, and a key with which to wind and exert pressure from the bottom of the tube.

Goodrich Spark Plugs

A new line of spark plugs is being manufactured and distributed under its own brand name by the B. F. Goodrich Co. The line includes 11 types of plugs for commercial use.

In its announcement notice, B. F. Goodrich declared that the line was released to the public only after months of research and testing during which every part of the plug was subjected to intense study before being placed in the product. Featured is a pre-testing

(*Turn to page* 69, *please*)

With Strike Under Way, GM Stands Firm on Basic Issues Involved

Corporation Refuses to Back Down on Its Position in Regard to Profits and Prices in Relation to Wage Rates

Rejecting a union proposal for arbitration by a three-man board and later turning down an offer to resume negotiations, GM has indicated that it does not intend to back down on its position in regard to profits and prices in relation to setting wage rates. Specifically, the union had proposed that the issue be submitted to a board composed of a representative from labor and management and a chairman selected by both. The board would have full access to the books and records of both parties and would render a decision final and binding on both parties. Any wage increase would be made retroactive to August 18.

Harry W. Anderson, GM vice-president in charge of personnel, stated that to accept the demand would be to abandon the rights of management to run its own business. It would mean, he said, that an outside party would take over the determination of what is a sound financial and economic policy for GM. He also pointed out that the union obviously knew its proposal was untenable, so that the offer was not made in good faith.

In turning down the offer to resume negotiations, Anderson stated that it would be useless to reopen discussions unless the union modified its unreasonable 30 per cent pay demand and abandoned its efforts to negotiate wages on the basis of past or assumed future profits and selling prices of the product. It should be clear to everyone, he said, that GM will not negotiate with the union regarding selling prices and profits. Thus, one week after the strike was called, the Corporation was standing firm on the basic issues involved in the struggle.

At the end of November the role of Government in the dispute was still uncertain. It appeared, however, that some effort should be made by the Department of Labor to bring the two parties together for talks in Washington, but there is now no indication that anything further than that can or will be done.

The strike has closed 80 of the 103 GM plants throughout the country and involves directly 175,000 production workers. Also involved are an undetermined number of salaried workers kept out of plants by picket lines, so that an overall estimate would put at 225,000 the number of persons thrown out of employment by the strike in GM alone. As the strike is prolonged, the number will increase steadily as parts plants close down and other automobile plants dependent on GM for parts are forced to suspend operations. Although other car manufacturers who had started production still were operating at the end of November, it appears certain that all of them, except possibly Ford, will have to close sooner or later if the strike continues. Most companies reported they could run until the first of the year on present stocks, but were uncertain how long after that they could continue.

Suppliers strikes halted most production departments at Ford for several days late in November, and the outlook for continued production is not good. The UAW-CIO promised to discuss strikes in plants supplying Ford, but to date has not made much progress. At the time of the curtailment at Ford, 15 suppliers were down with strikes, and many other reported they did not have enough men to maintain production at adequate levels.

Labor observers in Detroit do not look for any industrial peace for a long time to come. The GM strike may last for a long time, but even if it is short there still is plenty of trouble ahead with labor in both the automotive and the supplier industries. Steel workers are demanding a raise, glass strikes are in progress, stoppages exist in the bearing industry, and all down the line there is unrest and potential trouble. The production of new cars on anything like the scale predicted three months ago for early 1946 now appears to be far in the future.

General Tire Buys Pennsylvania Rubber Co.

The Pennsylvania Rubber Co., seventh in sales volume in the tire industry, has been purchased by the General Tire & Rubber Co. The Pennsylvania line of tires will be retained, as will the executive force and the dealer organization, according to William O'Neil, General Tire president.

Enlargement Program Will Provide More Facilities for Production of Flat Steel

By W. C. Hirsch

Coming at a time when uncertainty of the outlook obscured all market visibility, announcement by the leading steel producer of an extension program aimed at a considerable increase in rolling mill facilities for the production of automobile sheets and other flat steel chiefly consumed by automotive manufacturers has enhanced confidence in the metal market's long-range prospects. Contemplated are structural and mechanical additions and improvements which makes possible an increase in cold rolled steel output to 232,600 tons a year.

Perhaps more significant than the increase in tonnage output is the fact that this major enlargement program is concentrated on providing the automotive industries with more ample supplies of this particular steel, scarcity of which has added considerably to consumers' troubles. The mechanical design of the new mills will be such that they can easily be converted to the production of plates to take care of marine requirements, should the need for such arise. No one can foretell how competitive conditions in the steel market will shape up when the full effect of the pent-up demand for cars and trucks makes itself fully felt in a scramble for sheets and strip. It seems reasonably certain, however, that to make up for profit opportunities that were lost because of price control, all semblance of price wars will have to be averted. Ability to make shipments within a reasonable time will be the principal competitive weapon for a long time to come.

Because of the continuing shortage of the right sort of labor for manning sheet mills, backlogs have had to be further extended and some mills have been unable in recent weeks to accommodate even their pre-war customers with promises of earlier than late first quarter 1946 deliveries. Obviously, enlargement of capacity for the production sheets is hardly likely to have any untoward effect on the price set-up in this specialty field.

Packard Line for 1946

Following the initial announcement of the Packard Clipper 8 and the DeLuxe Clipper (AUTOMOTIVE *and* AVIATION INDUSTRIES, Nov. 15, 1945), the Packard Motor Car Co. states that the complete Packard line for 1946 will be in production in January. It will be available in the following models and body styles:

Clipper Six—120 in. wheelbase—6-pass., 4-door sedan and club sedan.

Clipper 8—120 in. wheelbase—6-pass., 4-door sedan and club sedan.

DeLuxe Clipper—120 in. wheelbase—6-pass., 4-door sedan and club sedan.

Super Clipper—127 in. wheelbase—6-pass., 4-door sedan and club sedan; 148 in. wheelbase—8-pass., 4-door sedan and limousine.

Custom Super Clipper — 127 in. wheelbase—6-pass., 4-door sedan and club sedan; 148 in. wheelbase—8-pass., 4-door sedan and limousine.

Three basic engines are offered for the 1946 models. The engine for the Clipper six is L-head, 6-cyl., 3½-in. bore by 4¼ in. stroke, 245 cu in. displacement, rated 105 hp at 3600 rpm with compression ratio of 6.71 to 1. It has autothermic aluminum alloy pistons and cast iron head.

The Clipper 8 and DeLuxe Clipper engine is L-head, 8-cyl., in-line, 3¼ in. bore by 4¼ in. stroke, 282 cu in. displacement, rated 125 hp at 3600 rpm with compression ratio of 6.85 to 1. It is fitted with autothermic aluminum alloy pistons and cast iron head.

All models of the Super Clipper and Custom Super Clipper have the same engine—L-head, 8-cyl., in-line, 3½ in. bore by 4⅝ in. stroke, 356 cu in. displacement, rated 165 hp at 3600 rpm with compression ratio of 6.85 to 1. It is fitted with autothermic aluminum alloy pistons and cast iron head.

An overdrive transmission is offered as optional equipment on all models.

Ford Truck Output Reduced Two-Thirds

Ford Motor Co. has reduced truck production about two-thirds following refusal by Kelsey Hayes Wheel Co. to furnish original equipment components at present ceiling prices. Output has been cut from 662 trucks a day to 220. Kelsey-Hayes said the decision was made because of OPA delay in acting on a petition for price relief or outright suspension of price controls over original equipment. Ford has been trying, without any apparent success, to find an alternate source of supply.

New Corporation Takes Over Cincinnati Lathe & Tool Co.

Incorporation papers were filed in Columbus, Ohio, for a new Cincinnati concern, Cincinnati Lathe & Tool Co., with an authorized capital of $100,000. The new company has acquired the land, buildings, machinery, designs, inventory, unfilled orders, and trade name of the Cincinnati Lathe & Tool Co., Oakley.

The new company is a subsidiary of the Cincinnati Milling Machine Co., but will be entirely independent in operation.

Republic Aviation Buys Aircooled Motors Corp.

Republic Aviation Corp. has entered into agreement to purchase outright the Aircooled Motors Corp. of Syracuse, N. Y., according to an announcement made by Alfred Marchev, Republic president, and confirmed by Carl F. B. Roth, president of Aircooled Motors.

Purchase for $1,500,000 of Aircooled Motors brings to Republic all rights for manufacture of the Franklin airplane engine, used by the Army during the war and scheduled to be used in many postwar light planes. The Republic Seabee, a four-place amphibian personal plane being built by the parent company, will be powered by a Franklin 212-hp engine.

Mr. Marchev will become chairman of the board of Aircooled Motors Corp., with Mr. Roth remaining as president.

Indianapolis Speedway Sold

The Indianapolis Speedway, long considered a proving grounds for automotive developments, has been sold by Capt. Eddie Rickenbacker to Anton Hulman, Jr., Terre Haute, Ind., financier. Purchase price is reported to be $750,000. Rickenbacker stated that he was disposing of the track because his duties as president of Eastern Airlines prevent his giving the plant the attention it requires.

Wilbur Shaw, who won the 500-mile race three times, has been named by the new management to be president and general manager. T. E. (Pop) Myers will remain as vice-president. The track will holds its first race since 1941 next May 30. The track is reported to be in good condition, but the stands will require extensive repairs after five years of idleness.

PUBLICATIONS

A new 28-page book, Bulletin C9-1, describing P & H **Grab Bucket Cranes,** has been issued by the Harnischfeger Corp. Construction details are given and various industrial applications are illustrated.*

Resistoflex Corp. has announced a new 16-page illustrated catalog describing the **Vulmaster,** an automatic vulcanizing machine. The catalog provides a complete description of the Vulmaster, with photographs of the machine in operation.*

Selecting the Right Thermosetting Molding Material is the title of a new 36-page booklet issued by Bakelite Corp. It is written as a companion piece for their new technical film, Bakelite Plastics—Selecting the Right Thermosetting Molding Material. The illustrated booklet, which expands and explains the subject matter of the film, is designed as a study booklet for the foreman, molder, engineer, designer, executive or plastics student. The booklet includes the Thermosetting Plastics Comparator, a special chart which shows the complex relative values of the various phenolic and urea molding plastics.*

An informative folder, describing Ex-Cell-O's facilities for manufacturing production parts and unit assemblies, is offered by the Ex-Cell-O Corp. Of special interest are its graphic interior photographs of Ex-Cell-O's production departments, showing the machinery used in parts output.*

Bulletin No. 24 on **Durite resins** for plaster of paris induration has been issued by Durite Plastics, Inc. Mixing procedure is described and tables show various formulas and how they increasse physical strength and chemical resistance of the plaster cast.*

Bulletin No. 56, describing **McKiernan-Terry Blacker Power Hammer,** has been issued by the McKiernan-Terry Corp. It gives detailed description of the hammer's design and construction with its specifications, supplemented by a concise tabulated list of the advantages and savings claimed for it. Photographic views of the hammer in several positions are shown.*

Ampco Metal, Inc., has issued Bulletin 58, **Ampco Metal in Dies,** which describes and illustrates the use of aluminum bronze alloy for die service. Topics discussed are the factors necessary for good forming and drawing die metal. Illustrations of dies and products formed by Ampco dies are included in the bulletin.*

Snap-On Tools Corp. has issued an attractive 25th Anniversary booklet covering its **Snap-On Wrenches** and **Blue-Point Mechanics Tools.** It is designated as Catalog Q and illustrates, describes, gives prices and specifications for general tools in sets and various types of wrenches, pliers, service tools, pulling equipment, electric drills, etc.*

A new catalog No. 2010-B has been issued by the Heavy Machinery Div. of The Cleveland Crane & Engineering Co. describing **Cleveland Steelweld Bending Presses and Bulldozers.** Details of construction are illustrated and tables of dimensions and specifications included. Data is also provided on special bed and ram designs.*

A revised edition of **The American Line** a 24-page reference catalog of the entire line of products manufactured by American Foundry Equipment Co., has been released.*

A new Vanadium-Alloys Steel Co. booklet describing the company's complete line of **high speed tool bits** and **Lamite Cutting Tools** has just been published. The first section of the bulletin is designed to simplify the selections of the proper high speed steel bit for any application and includes descriptions of Vanadium's Red Cut Superior, 6-6-2, E.V.M., Red Cut Cobalt, Neatro, Victory Cobalt and Vasco M-2. The second section gives complete details on Lamite cast alloy cutting tools.*

A new 24-page bulletin containing data and descriptive information on the complete line of **portable, a-c test sets** from 2000 to 150,000 volts, has been announced by the General Electric Co.*

A new illustrated catalog on **Rapid-Wheel Gravity Conveyors** has been published by The Rapids-Standard Co., Inc. It contains information concerning construction features and uses of the 8 Rapid-Wheel Conveyor models available, together with complete specifications and data on standard accessories manufactured for use with the conveyors. It also shows on-the-spot photographs of the conveyors in action on all types of conveying jobs.*

Sciaky Bros. has issued Bulletin 122-A on its **OWH Series of hydraulically operated portable spot welders.***

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* Obtainable by subscribers within the United States through Editorial Dept., AUTOMOTIVE *and* AVIATION publications, be sure to give date of the issue in which the announcement appeared, your name and address, company connection and title.

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PERSONALS

Recent Appointments Among Automotive and Aviation Manufacturers:

Eaton Manufacturing Co., Eaton Foundry Div., **Edward C. Hoenicke**, Gen. Mgr.; Wilcox-Rich Div., **Sidney Oldberg**, Executive Engineer.

Bendix Aviation Corp., Eclipse Machine Div., **Maurice P. Whitney**, acting Gen. Mgr.; Bendix Products Div., **M. E. Hickman**, Division Sales Staff.

Graham-Paige Motors Corp., Warren City Mfg. Co. Div., **Harold E. Bliss**, Asst. Secretary and Asst. Treasurer in chg. of Financial Dept.

The Glenn L. Martin Co., Commercial Sales Group, **M. M. Maxfield**, Sales Engineer of new Model 202 passenger luxury transport.

Stewart-Warner Corp., Heater Plant, **Lewis A. Rodert** has joined research staff.

Young Radiator Co., **William J. Schlapman**, Adv. and Sales Promotion Mgr.

General Motors Corp., Accessory Divisions Group, **F. L. Burke**, executive in charge.

Allegheny Ludlum Steel Corp., **P. E. Floyd**, Manager of Sales, newly created carbide alloy sales div.

General Motors Corp., Pontiac Motor Div., **Lieut. Commander Paul R. Warmee**, to newly created post of Advertising and Sales Promotion Mgr.

Hughes Aircraft Co., **Hugh McL. Fenwick**, General Sales Mgr.

Carboloy Co., Inc., **Donald L. Schwartz**, Research Metallurgist.

Wagner Electric Corp., **J. D. Eby**, elected Secretary in addition to his present post of Manager of Purchases.

Standard Oil Co. of N. J., **John B. Tuttle** and **Charles W. Bohmer**, Asst. Mgrs. of Sales Engineering Dept.

Bell Aircraft Corp., **John Snure, Jr.**, Director of Public Relations.

Gar Wood Industries, Inc., **Lt. Commander Herbert F. McClure**, Sales Engineer of Hoist and Body Div.

White Motor Div., **William J. Cumming**, Supt. of Field Service Operations.

Sperry Gyroscope Co., **P. R. Bassett**, elected President.

Continental Motors Corp., Aircraft Div., **William Wiseman**, Asst. Chief Engineer.

Douglas Aircraft Co., **Cliff Johnson** has joined publicity dept.

Kaiser-Frazer Corp., **Edgar Kaiser**, elected a member and vice chairman of the Board of Directors. **H. C. McCaslin**, elected Vice-President and a Director.

Northrup Aircraft, Inc., **Frank W. Jones**, head of Light Metals Products Div.

Mack-International Motor Truck Corp., **Lt. Col. H. P. Valentine**, Mgr. of Dealer Sales and Operations. **Major F. R. Nail**, Asst. to the Chief Engineer in chg. of Highway Truck Developments.

Westinghouse Electric Co., Motor Div., Welding Dept., **Charles H. Jennings**, Engineering Mgr.; **John H. Blankenbuehler**, Mgr. of Arc Welding Apparatus, and **E. Hill Turnock, Jr.**, Mgr. of Arc Welding Electrodes.

Casco Products Corp., **Jack Schenberg**, Director of Merchandising.

Fairmount Tool & Forging Co., **Ernest Spuhler**, General Sales Mgr.

Greer Hydraulics, Inc., **Carl J. Snider**, Chief Engineer in chg. of development of aircraft hydraulic testing machines and maintenance equipment.

Ellinwood Industries, **LeRoy Barrett**, Executive Engineer.

Reynolds Metals Co., Aluminum Div., **Albert H. Charlton**, Sales Mgr.

Radio Receptor Co., Inc., New Selenium Rectifier Div., **Julian Loebenstein**, Sales Mgr.

The Glidden Co., **W. R. McKenney**, Industrial Sales Promotion Mgr.

Kropp Forge Co., **James E. Sweeney**, Vice-Pres. and Gen Sales Mgr.

The Teleoptic Co., **Major Matt R. Korshin**, Gen. Sales Mgr.

The Protectoseal Co., **John W. Mock**, Sales Mgr.

Rheem Research Products, Inc., **Clarence H. Sample**, Chief Engineer.

National Malleable and Steel Castings Co., Sharon Works, **Paul E. Tamplin**, Mgr.

General Controls Co., Refrigeration Div., **J. M. Schlemmer**, Divisional Sales Mgr.

National Motor Bearing Co., Arrowhead Rubber Co., **Earl F. Boyes**, Sales Mgr.

Snyder Tool and Engineering Co., **Larry S. Andrich**, Vice-Pres. and Gen. Mgr.

Lynch Mfg. Corp., **G. C. Davis**, Chief Engineer.

Atlas Powder Co., Explosives Dept., **Weston G. Frome**, Gen. Mgr.

Donaldson Co., Inc., **John C. Enblom**, Pres. and Gen. Mgr., St. Paul Plant.

Allis-Chalmers, Basic Industries Dept., **G. V. Woody**, Mgr., succeeding R. C. Newhouse.

Carbide Die and Mold Co., **William C. Uecker**, Treasurer and Sales Mgr.; **Ernest G. Merlin**, Secretary and Sales Representative.

Caterpillar Tractor Co., Adv. Dept., **Gordon W. Monfort**, Director of News Bureau.

Aireon Mfg. Corp., Hydraulic Div., **Ralph E. Middleton**, Gen. Mgr.

The Keystone Alloys Co., **John E. Nipar**, Mgr. of Sales and Distribution for Powdered Metals and Powder Metallurgy Parts.

The Acklin Stamping Co., **F. Cyril Greenhill**, President and Director; **Alvin E. Seeman**, Exec. Vice-Pres., Treasurer and Director; **Harry F. Smith**, Vice-Pres. in chg. of Mfg.; **George J. Bleim**, Vice-Pres. in chg. of Purchasing; **George F. Medill**, Secretary and Director; **Dewitt L. Mielke**, Asst. Treas. and Asst. Sec., and **Roy W. Kraft**, Director.

Sun Oil Division to Conserve Gas Resources

Appointment of James E. Pew as manager of a new Division of Natural Gas and Natural Gasoline was announced by J. Edgar Pew, vice-president of Sun Oil Co. The new division, which will function as a part of the Company's production department, was created as a further development in an aggressive program for the conservation and efficient utilization of gas resources.

Simultaneously, the new manager announced the appointment of Charles E. Webber as his assistant. Their headquarters will be in Philadelphia.

The appointments do not involve any changes in local management.

Aeroproducts Propellers Used on New Plane

Aeroproducts propellers have assignments on another new airplane, according to an announcement by W. J. Blanchard, general manager of Aeroproducts Division, General Motors Corp., at Vandalia.

The plane is the new Navy fighter, XF-8-B1, built by Boeing at Seattle, Wash., with a dual rotation Aeroprop as the medium of propulsion. This big single-engine fighter carries over 6000 lb of bomb and torpedo load and flies at between 400 and 500 mph.

CALENDAR

Conventions and Meetings

SAE Natl. Air Transport Engineering Meeting, Chicago, Ill.	Dec. 3-5
Natl. Assoc. of Manufacturers, New York City; Golden Anniversary Congress	Dec. 5-7
Miami All American Air Maneuvers, Miami, Fla.	Jan. 4-6
SAE Annual Meeting and Engineering Display, New York, N. Y.	Jan. 7-11
Plastics Exhibit, Detroit	Jan. 7-11
American Society for Metals, Cleveland-Natl. Metal Show	Feb. 4-8
American Society for Testing Materials, Pittsburgh Spring Meeting	Feb. 25-Mar. 1
Pan-American Aircraft Exposition, Dallas	Mar. 1-5
American Management Association, Atlantic City, N. J., Packaging Exposition	Apr. 2-5
SAE Natl. Aeronautic Meeting, New York, N. Y.	Apr. 3-5
Midwest Power Conference, Chicago	Apr. 3-5
American Society of Tool Engineers, Cleveland Tool Engineers Exposition	Apr. 8-12
Natl. Assoc. of Corrosion Engineers, Kansas City, Mo., Annual Meeting and Convention	May 7-9
Associated Business Papers, Hot Springs, Va., Spring Meeting	May 22-25
American Society for Testing Materials, Buffalo Annual Meeting	June 24-28

British Car in Lowest-Price Class

This "People's Car," the Kendall, is powered by a three-cyl, radial, 700-cc, air-cooled engine, located over the rear axle. Hydraulic buffers are used in place of springs on the independently-sprung rear wheels. The engine, which develops approximately 20 hp, is cooled by air taken through the grille and passed along a duct below the body. The maker expects to sell the car for about 100 pounds.

AUTO-LITE

FOR a third of a century Auto-Lite has been building automotive electrical systems. The dependable service delivered by this equipment is evidenced by the fact that one in every two car makers today specify electrical systems built by Auto-Lite. It is this acceptance, built on outstanding performance, which has made Auto-Lite the world's largest independent manufacturer of automotive electrical equipment.

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AUTO-LITE MEANS THE LIFE-LINE OF YOUR CARS, TRUCKS, BUSES

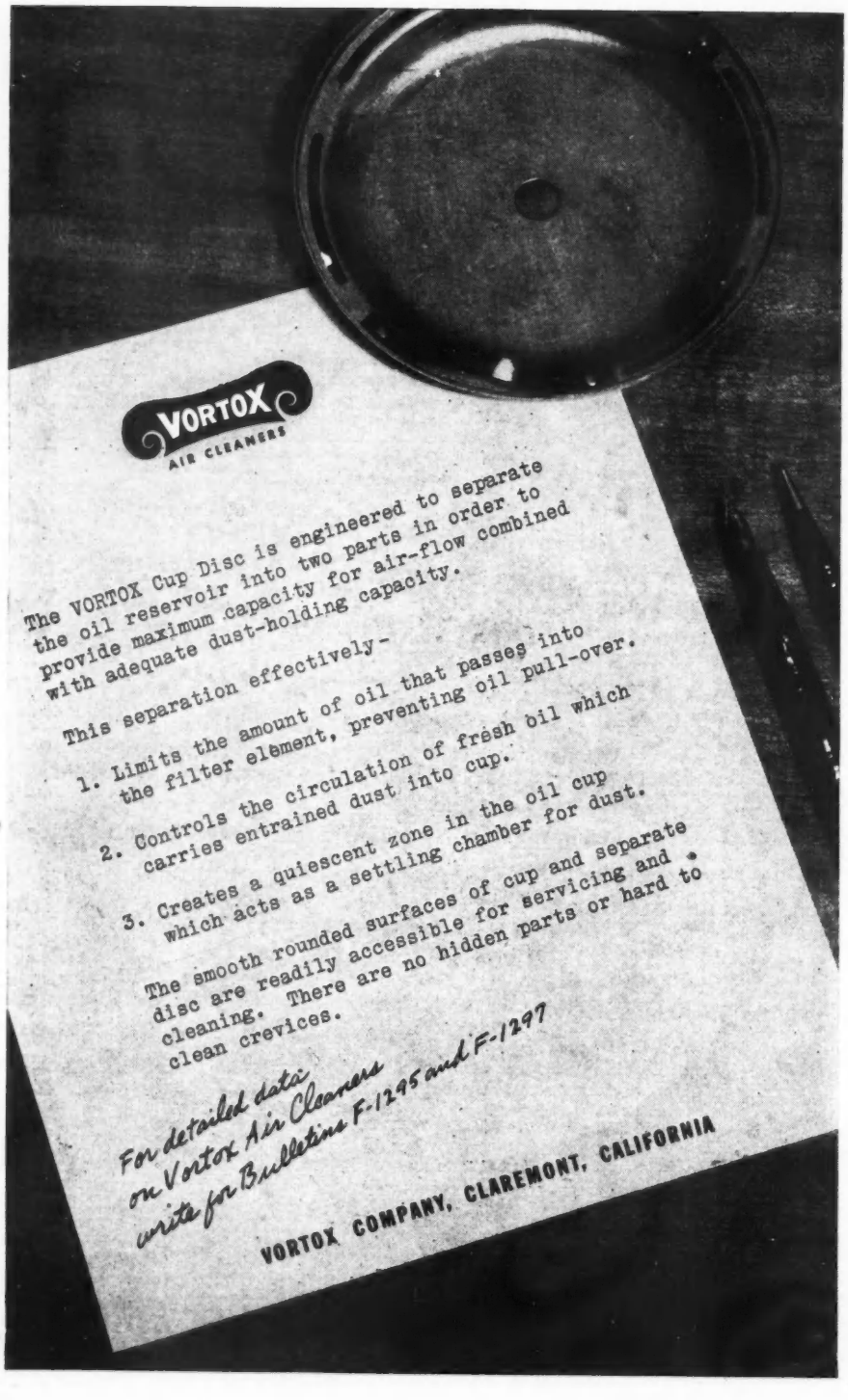
Du Pont Not a Stockholder in Farbenindustrie

According to E. I. du Pont de Nemours & Co., recurring reports from Germany giving the impression that the Du Pont Co. is a substantial stockholder in I. G. Farbenindustrie are entirely incorrect. The Du Pont Co. states that it has no investment whatever in I. G., or any of its subsidiaries.

The latest of these reports is a statement attributed to Colonel Edwin S. Pillbury, identified as Farben industry control officer in Germany.

The only stock interest Du Pont ever had in I. G. Farben, in fact, came as a result of an investment of $1,785,522 made in 1925 in the stock of two German explosives firms, Dynamit A. G. and Koln-Rottweil, which later were merged with or came under the control of I. G. The Koln-Rottweil shares were converted into I. G. shares. The investment was later increased, by the exercise of purchase rights, to a total of $2,395,316, which was approximately one-half of one per cent of the issued shares of that company.

Du Pont began disposing of its investments in I. G. in 1933. Sale of its whole remaining I. G. investment was authorized by Du Pont in 1934. This proved difficult because of currency regulations and blocked mark requirements. The I. G. stock was, however, fully disposed of in 1940, at a loss of $671,406, and the Dynamit A. G. shares, sold at the same time, were liquidated at a loss of $534,359.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The VORTOX Cup Disc is engineered to separate the oil reservoir into two parts in order to provide maximum capacity for air-flow combined with adequate dust-holding capacity.
This separation effectively-
1. Limits the amount of oil that passes into the filter element, preventing oil pull-over.
2. Controls the circulation of fresh oil which carries entrained dust into cup.
3. Creates a quiescent zone in the oil cup which acts as a settling chamber for dust.
The smooth rounded surfaces of cup and separate disc are readily accessible for servicing and cleaning. There are no hidden parts or hard to clean crevices.
For detailed data on Vortox Air Cleaners write for Bulletins F-1295 and F-1297
VORTOX COMPANY, CLAREMONT, CALIFORNIA

Westinghouse Building Gas Turbine Engine Plant

The new plant and research laboratory, now being built at Lester, Pa., by the Westinghouse Electric Corp. in conjunction with the U. S. Navy for the engineering and manufacture of gas turbine engines of the jet and propeller propulsion types, will represent an investment of $10 million and are expected to be completed early in 1946, according to George H. Woodward, manager of the Westinghouse Aviation Gas Turbine Division. The plant is designed to produce from $10 million to $15 million worth of aviation gas turbine engines per year when operating at maximum capacity. Both commercial and military engines will be produced there.

The $3 million engineering laboratory is to be devoted exclusively to the development of gas turbines. It is now being equipped to develop and test separately the major components of the engine.

The Westinghouse quantity production program was originally scheduled to start about the middle of 1946 and this production program still stands, company officials state. At present the division has 1100 employes and by the end of 1946 it is expected that employment will be 1500 to 2000.

Fatigue Damage

(*Continued from page* 24)

and still not fail when "run out" at the endurance limit. The normal scatter in fatigue testing, however, accounts for this behavior in occasional specimens.

The accuracy of test results is particularly important in attemtping to establish damage information. Small inaccuracies in loading (which are not so likely in rotating beam machines, but are very common in axial-loading types) will result in very large variations in the number of cycles to failure. Considering the usual large scatter, the results obtained in the tests of Tables I and II are felt to be both accurate and significant. The average value for $\Sigma \frac{n}{N}$ is 1.015 for the 22 specimens. The maximum and minimum values are 1.45 and 0.61, respectively. Inspection of an S-N curve on which are plotted actual test points will show that the scatter of these maximum and minimum values is not excessive (see Fig. 158, page 202 of Ref. 2).

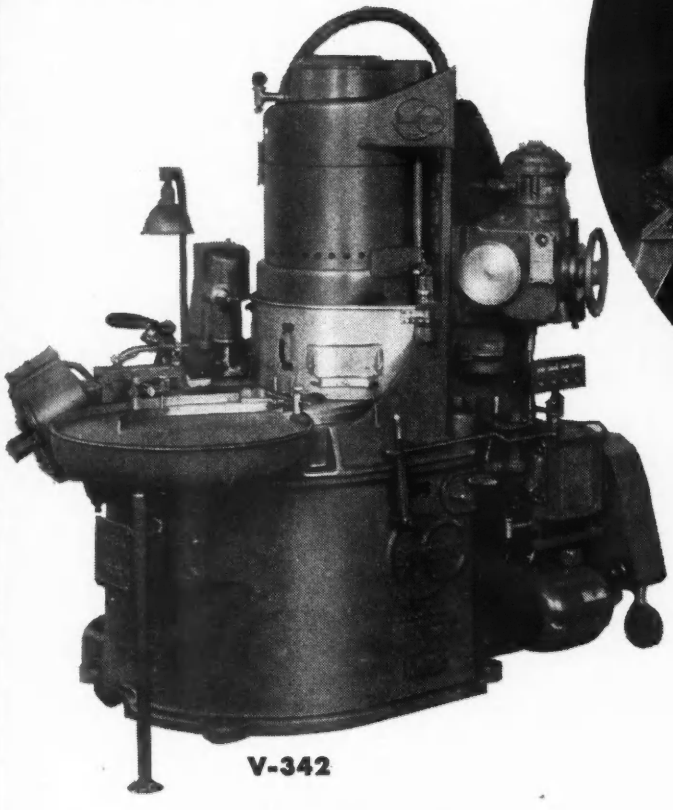
Sample Analysis

The problem is to find the expected life in hours of a hydraulic pressure unit.

Assume that the pressure vessel is

(*Turn to page* 58, *please*)

"Put it on the Blanchard"



V-342

These 3" x 1⅝" x ⅜" Cold Rolled Steel Punchings are ground on a No. 16-A Blanchard Automatic Grinder to very close limits and with high production.

In a roughing operation and with one pass under the wheel, .014" of stock is removed. A finish operation grinds to limits of ±.0005". Production is 235 pieces per hour completely finished, which involves the grinding of two sides twice or 940 surfaces per hour.

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- **Adaptability**
- **Fixture Saving**
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- **Fine Finish**
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Send for your free copy of "Work Done on the Blanchard", third edition. This new book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

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The BLANCHARD MACHINE COMPANY

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made of aluminum alloy and operates from 1500 to 3000 psi during part of its operation and from 600 to 3000 psi during the remainder. The system operates at 20 cpm under accelerated test conditions and 60 per cent of these operating cycles are of the former type. At 3000 psi pressure, the maximum tensile stress is known to be 35,000 psi in the critical region.

$$\text{Now } R_1 = \frac{1500}{3000} = +0.50$$

$$\text{and } R_2 = \frac{600}{3000} = +0.20$$

Also, $n_1 + n_2 = 20$ cpm
or effectively,

$$n_1 = 0.6 \times 20 = 12 \text{ cpm}$$

$$n_2 = 0.4 \times 20 = 8 \text{ cpm}$$

Now from an S-N curve for the material in question (values are assumed for this example),

N_1 = 1,000,000 cycles to failure at 35,000 psi and $R = +0.50$.

N_2 = 215,000 cycles to failure at 35,000 psi and $R = +0.20$.

Now, $\frac{n_1}{N_1} + \frac{n_2}{N_2} = \Sigma \frac{n}{N}$ = portion of total life consumed per minute of operation.

$$\text{or } \frac{12}{100 \times 10^4} + \frac{8}{21.5 \times 10^4} = 0.49 \times 10^{-4}$$

And since failure occurs at $\Sigma \frac{n}{N} = 1$, the pressure unit can be expected to fail in $\frac{1}{0.49 \times 10^{-4} \times 60} = 340$ hours of continuous operation under these accelerated conditions.

Of course for an actual case, there are several problems which arise to make the determination of fatigue life anything but simple, such as the example that is illustrated. The determination of the working stress and number of cycles of operation is usually a difficult matter, involving precise instrumentation and careful experimental work or a very careful evaluation of service experience and the other factors that can be determined. Then, too, S-N curves are required for the particular part in question. However, if the critical region of the part is known to have negligible stress concentration, *S-N* curves of the basic material can be used.

An actual problem involving aluminum hydraulic pressure accumulators has been successfully solved by the procedures outlined. The accumulators were made of forged 14ST aluminum alloy, for which basic material *S-N* curves were available. Test runs on the accumulators indicated that a relatively small number of cycles occurring at a lower stress ratio but at the same maximum stress might be causing premature failures. Analysis of the various possibilities for fatigue failure in the different type systems in which the accumulators were used indicated that one system was entirely satisfactory while another was not. Actual service experience proved the analysis to be correct in both cases. A long history of satisfactory service existed in one case, while in the other, several failures had occurred in a relatively short length of time.

Conclusions

From the evidence available at present, it is concluded that the concept of cumulative damage:

1. Holds true for Alclad 24ST aluminum alloy and probably for the other high-strength aluminum alloys.
2. Provides a simple, practical (and conservative) means for analyzing fatigue problems.
3. Should be experimentally investigated for steels and other materials to determine its range of usefulness.

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THIS REVOLUTIONARY NEW METHOD of dressing grinding wheels, with its much greater accuracy and increased speed, is taking industry by storm.

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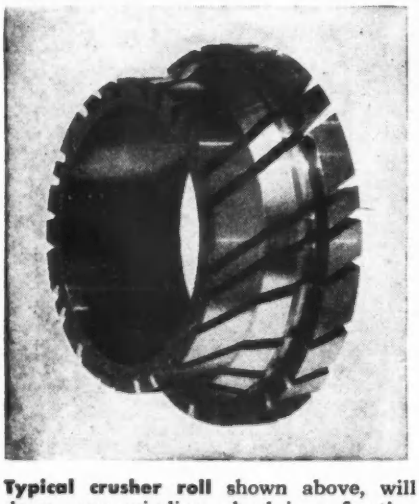
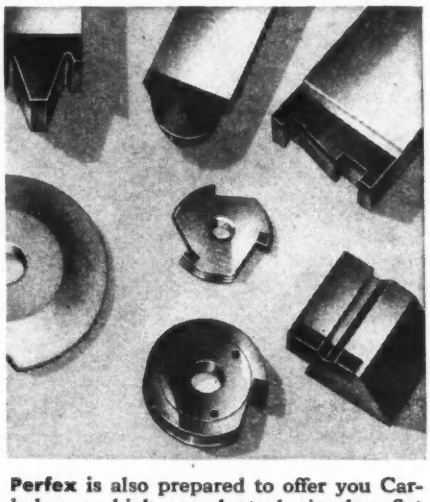


Typical crusher roll shown above, will dress your grinding wheel in a fraction of the time previously required and with greater accuracy.



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If you are not already familiar with the story of crush dressing of grinding wheels, we will be glad to answer your questions. Write us today or ask for quotations.

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SAVES $1.00 Hr. TOOL GRINDERS' TIME

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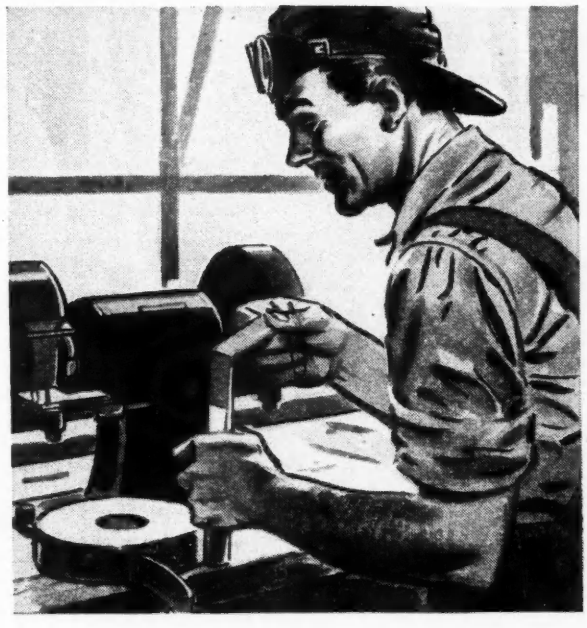

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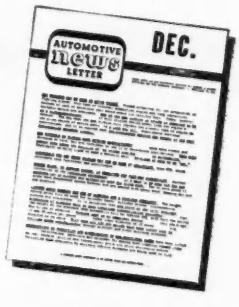

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Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Increasing general business activity has been indicated. *The New York Times* index for the week ended November 3 stands at 122.8, as against 118.9 for the preceding week and 140.1 a year ago.

Electric power production during the week ended November 10 was moderately increased. The output, accordingly, was 10.2 per cent below that a year ago, as against a comparable decline of 10.5 per cent in the preceding week.

Railway freight loadings during the same period totaled 838,218 cars, 1.6 per cent below the figure for the preceding week and 0.2 per cent below that for the corresponding period last year.

Crude oil production in the week ended November 10 averaged 4,451,200 barrels daily, 132,850 barrels above the output a week earlier but approximately 6 per cent less than the corresponding quantity last year.

Bituminous coal and lignite production during the week ended November 3 totaled 12,470,000 net tons, 2.8 per cent more than the output a week earlier and 3.7 per cent above that a year ago. Total production thus far this year is 9.3 per cent less than the comparable output in 1944.

Civil engineering construction contracts awarded during the week ended November 15 resumed an upward trend, according to *Engineering News-Record*. The total of $76,318,000 is 67 per cent above the figure for the preceding week and 159 per cent greater than the corresponding amount last year. The aggregate value of contracts recorded for 46 weeks of 1945 is 23 per cent more than the comparable sum shown in 1944.

The wholesale price index of the Bureau of Labor Statistics for the week ended November 10 registered a further advance to 106.1 per cent of the 1926 average, as against 105.9 a week earlier and 104.1 a year ago.

Member bank reserves increased $257,000,000 during the week ended November 14. Underlying changes reflected include an increase of $621,000,000 in Reserve bank credit and a rise of $319,000,000 in Treasury deposits with Federal Reserve banks, accompanied by an increase of $41,000,000 in money in circulation.

Total loans and investments of reporting member banks rose $89,000,000 during the week ended November 7. A rise of $152,000,000 in commercial, industrial and agricultural loans was recorded. The sum of these business loans, $6,480,000,000, shows a net increase of $193,000,000 in twelve months.

Chrysler Soon Will Be in Production

Chrysler Corp. now expects that new car production will get under way this month and reach full production by next March. K. T. Keller, president, reported to stockholders that reconversion is progressing faster than had been expected and that if other factors do not interfere, the company will be ahead of its previous starting schedule.

It's "quick-change"
THE BLOCK
THE BAR
AND THE SPRING CLIPS
SLIP BLOCK IN BAR
TO REMOVE BLOCK INSERT SCREWDRIVER IN CLIP OPENINGS AND PRY UPWARD
AND BLOCK WILL SLIDE OUT OF BAR
SLIGHT CLOCKWISE MOVEMENT ENGAGES BLOCK
HERE
AND HERE
AND IT IS CENTRALIZED ON THE BAR, SECURED IN PLACE BY SPRING CLIPS
THE GAIRING
BLOCK-TYPE BORING TOOL
Designed for Production on Rough Boring, Semi-Finishing and Reaming Operations
This quick detachable cutter block provides self-centering, positive locking, quick inserting of block in boring bar and easy removal, without the aid of locating holes or screws, keys, wedges or taper pins.
The block containing the fully adjustable blades is simplicity itself. Made to engage both sides of the precision ground flats on the bar it quickly and accurately centers itself. When located, the cutting thrust ure is evenly distributed against the back and bottom of the slot. ew tool combines quick change, positive drive and accuracy idity is assured because the bar is free from centralizing
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UICK-CHANGE" BLOCK WORKS
block through the slot in the bar until the pro- ge the ground flats on the bar. It is then perfectly in spring clips which hold the block in place and l the unit from dirt, chips, etc. To remove Block flip engage the contact surfaces and withdraw the block.
NEWS FLASH

An eight-page brochure illustrating and describing Gairing's new Block-type Boring Bar is now ready for distribution. It contains information never before available.

The money-saving simplicity of this new tool, its unique quick-change and self-centering features are fully explained in terms that anybody can understand.

Every production engineer in the metal working industry, every tool supervisor, every master mechanic should have a copy of this book.

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Every 8½" x 11" page, and there are eight of them, is chock full of usable information . . . fully illustrated . . . text is reinforced with many charts and diagrams.

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DESIGNERS AND MANUFACTURERS OF STANDARD, SPECIAL AND INSERTED BLADE END CUTTING TOOLS

Utilization of Atomic Energy

(*Continued from page* 19)

Full speed ahead would be achieved by pulling out the cadmium "throttle." A distinct advantage for naval vessels would be that "refueling" would be infrequent. An additional consideration would be that the atomic fuel is nonflammable. Shielding would be a major problem, and would add considerably to the weight and size of the units. Such applications of atomic energy might be entirely ruled out on this basis alone.

Pure U-235 and plutonium in excess of the critical sizes can be assembled—provided cadmium, boron, or some other neutron absorber is present in sufficient amount to prevent the chain reaction. If the absorber were gradually removed until the critical point is reached, a controlled release of energy from a very compact source might be possible. However, with pure U-235 or plutonium, this procedure would be extremely sensitive—a slight movement of the absorber might result in a violent explosion. For this reason, compact units will probably use a mixture of U-235 and U-238, containing not more than about 20 per cent of the lighter isotope and some moderator in order to obtain a safe degree of controllability. Even more problems than arise with the larger units must be solved before diminutive atomic engines will be possible. For military purposes such engines might supply the power for guided missiles or robot planes. In order to compete seriously with Diesel oil and gasoline, atomic engines must be adaptable to trains, trucks, planes, and automobiles. For these purposes the shielding problem would be most acute. The compactness gained in using atomic fuel might be more than offset by the large amount of shielding required. Of course, all of these considerations have been limited to the source of atomic energy now known; i.e., to nuclear fission of heavy elements. It will be recalled that the consolidation of light elements into medium-weight elements releases comparable amounts of energy. Although such nuclear syntheses have never been accomplished on a large scale, they have been achieved in minute amounts in the laboratory. If future research extends the range of available atomic energy to include the light elements, many of the foregoing limitations may be removed. In addition, these light elements would probably be far more plentiful than the relatively scarce fissionable elements, uranium and thorium.

Within the bounds of available information, it would appear that petroleum and coal will probably continue for at least another generation as the primary sources of energy for transportation and heating. Water power and coal will probably generate most of the electricity during the next 50 years. Although atomic energy may gradually enter as a competitor, its most extensive applications will probably be in new fields of human endeavor. Industrial processes at extremely high temperatures, ultra-high-speed transportation, the production of radioactive materials for industrial and medical purposes as well as for some scientific investigations, the manufacture of rare elements by transmutation, and the treatment of materials by radiation are among the more likely specialized uses of fission energy in addition to the continued production of atomic explosives.

For some time the more conservative members of the petroleum industry have been concerned about what the world would use for fuel when the petroleum and coal reserves were exhausted. Prior to 1935 new discoveries more than offset the increased consumption of petroleum. During the past 10 years the discovery rate has rapidly declined while production has soared. Although there will be a postwar respite, this trend is likely to continue for some time. However, the petroleum industry now has somewhat less occasion to regret the expenditure of a large part of the earth's supply

(*Turn to page* 66, *please*)

New Precision Built Roto Center Eliminates Chatter... Speeds Production!

Now You Can replace dead centers on lathe and grinder tailstocks, with this new Keene live Roto Center—to increase production—to eliminate all radial play and possibility of chatter! Low in cost, the Roto Center is a high capacity unit, featuring many innovations to speed and improve quality of work!

Matched roller bearings preloaded, are packed with high grade anti-friction grease at assembly. No attention is required for long periods. After assembly, runout is kept to absolute minimum—guaranteed less than .0002. Rear of center is tapped to receive standard hydraulic fitting. Chips, dust and cutting oil cannot reach bearings!

More and more peacetime "helps on the job" are returning to industry. One of these days, famous, flavorful Wrigley's Spearmint Gum will also be back to help you "on the job"—but only when we can assure Wrigley's Spearmint manufacture in *quantity* and *quality* for all. Today, we ask you to remember the famous Wrigley's Spearmint wrapper. Tomorrow, you may again enjoy Wrigley's Spearmint Gum quality and flavor while you are at work.

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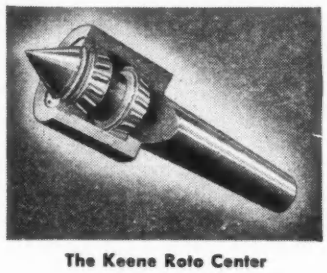

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Regulating wheel and grinding wheel are each a self-contained, enclosed unit mounted on separate bases, individually adjustable.

Clean, modern lines at sides and back too. Hinged covers and doors permit easy access to all operating parts for inspection and maintenance.

LANDIS TOOL

Precision Grinders

LANDIS TOOL COMPANY

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G'WAN, GET OUT! I DON'T WANT NO TIDYER AROUND ME--I GIT ENOUGH O' THAT AT HOME!
HE'S OF THE OLD SCHOOL--BUT HE'LL CHANGE HIS TUNE WHEN SPEEDI-DRI SAVES HIM FROM GETTIN' HIS EARS CHAWED OFF IN THAT MACHINE!
SPEEDI-DRI
J.R.WILLIAMS
THE NEW ORDER
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For firm, safe footing . . . for floors that are home-clean, free from dangerous, ice-slick oil- and grease-deposits . . . the answer is SPEEDI-DRI!

SPEEDI-DRI . . . the oil-thirsty, granular absorbent . . . puts down a magic carpet that's safe for working . . . safe for walking. No expensive machinery . . . no trained personnel . . . is required to apply SPEEDI-DRI.

Just spread it around over offending surfaces . . . and you've got safety underfoot. Sweep it up, and your floors are bone-clean. SPEEDI-DRI will remove even ancient oil- and grease-deposits.

SPEEDI-DRI *saves* in more ways than one. It releases cleaning-personnel for more productive work. It pushes production up by eliminating fatigue and preventing falls. SPEEDI-DRI will not readily burn even when oil-soaked and is widely recommended by leading insurance companies. In addition, it is not necessary to interrupt production-schedules to apply SPEEDI-DRI. It works . . . while *you* work in safety!

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SPEEDI-DRI
OIL AND GREASE ABSORBENT

of chemical energy. By the time this source is exhausted, there should be plenty of atomic energy available.

Although this change seems inevitable, it will certainly not be rapid. Few of us will live to drive atomic automobiles or fly jet planes powered by nuclear energy. When this time arrives, there will still be a petroleum industry, but it may have changed rather remarkably in character. Instead of petroleum being primarily used for fuel, it will be the raw material for all kinds of organic substances.

Already it sometimes seems a waste to burn hydrocarbon molecules when they can be converted into valuable compounds like synthetic rubber, toluol, polymerized lubricants, plastics, and medicinal substances. The war has emphasized the importance of petroleum as a source substance in organic synthesis. An increase in the availability of atomic energy, together with an increase in the knowledge of the organic chemistry of petroleum, should result in considerable expansion of the chemical utilization of petroleum. The refinery of the future will be more of a chemical factory than a producer of fuel.

Aircraft Engine Progress

(*Continued from page* 42)

tion of increased fuel quantity vs. fuel quality almost forced a slowing of the upward swing in power during this period. However, water injection, by providing a means of internal cooling and absorbing the peak from the heat of combustion within the combustion chamber, permitted the use of higher pressures and, consequently, more power. Fortunately the American engine designer and metallurgist had done their work well and the engines, with some changes found necessary as a result of tests, were able to give a good account of themselves when operated under the new powers.

Further advances in power, as indicated by the rather abrupt rise on the chart between the years 1944 and 1945, represent new engine models with all known improvements resulting from experience gained during the operation at the higher combat horsepowers and, most important of all, also records the point where fuel quality was again advancing and increased rating again reflects the designers challenge to utilize this advantage together with the war-proven use of water injection.

Stanley Receives Degree of Doctor of Engineering

George J. Stanley, director and vice-president of Aluminum Company of America, recently received the honorary degree of Doctor of Engineering at the fiftieth anniversary Convocation of Clarkson College of Technology, Potsdam, N. Y.

New Products

(*Continued from page* 48)

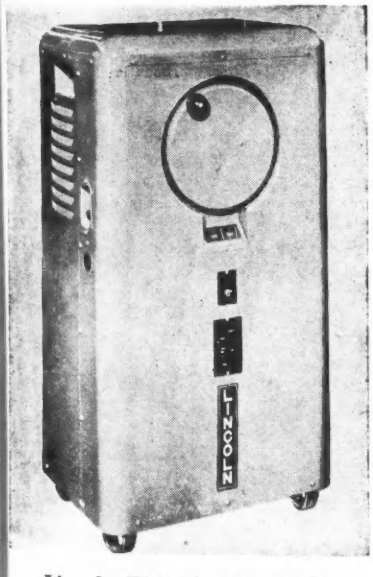
program which guarantees that every plug will render the service for which it is designed, the company says.

Welder for Use on Rural Power Lines

A new low-priced welder designed for use on rural power lines has just been introduced by the Lincoln Electric Co., Cleveland, Ohio.

The new unit, called the "Fleet-Arc Jr.," is for 230 volt, single phase power lines and meets the limited input requirements of rural utilities and REA by a design of high efficiency and high power factor. It has a maximum input current of 35 amp and provides a machine which meets the new NEMA standards for this type of welder. It can be used with the standard 3-kva power transformer provided by the power company. Current range is from 20 amp at 20 volts to 180 amp at 25 volts welding duty. This gives sufficient capacity for all types of jobs found in most job welding shops. It will handle electrodes ranging from 1/16 in. to 5/32 in. diameter.

The "Fleet-Arc Jr." inaugurates a development known as the "Arc Booster," which provides quick, easy arc starting. The instant the electrode



Lincoln Fleet-Arc Jr. welder

touches the work, the welding current is given a boost of intensity for starting the arc.

The current then reverts automatically to the amount set for the job. No high voltages or special high frequency devices are used, the output voltage being limited to a maximum of 52 volts.

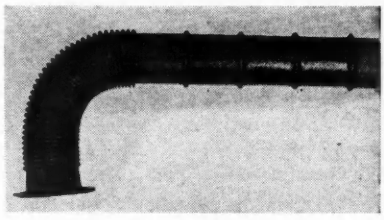
Either of the two degrees of arc boosting provided is selected by a snap switch, one for general work and the other lower amount for thin material such as automobile fenders.

Current control for the new "Fleet-Arc Jr." is of the separate adjustable reactance type which is varied by turning a hand wheel. Adjustment is continuous over entire welder range of from 20 to 180 amp.

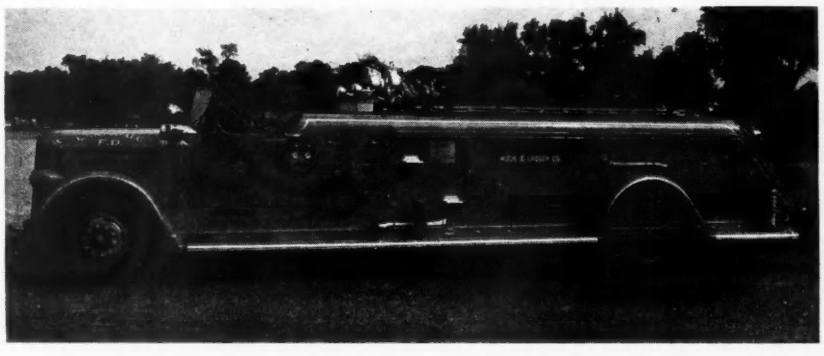
Ducting Material for Hot or Cold Air

A new material, "Airtron," created during the war for aircraft heating and ventilating, is now available to other manufacturers as a ducting for hot or cold air. Made of glass cloth and rubber, it provides high insulation qualities as well as great flexibility. The flexibility makes its use desirable

(*Turn to page* 70, *please*)



Airtron tubing

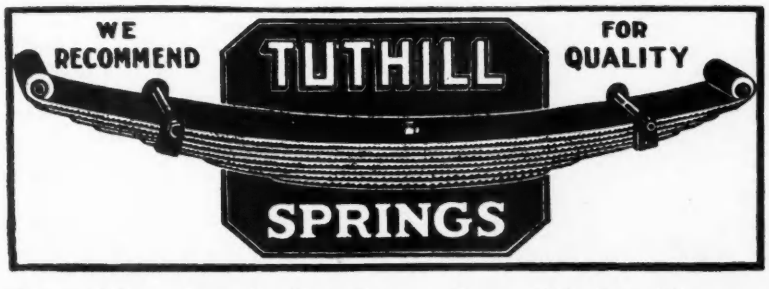


Equipment with "Fighting" Ability

QUALITY Tuthill Leaf Springs add a final touch of ruggedness and durability to this hook-and-ladder fire-fighting unit. Built by Ward LaFrance Truck Division of Great American Industries, Inc., Elmira, N. Y., it is the "last word" in modern, streamlined, effective fire-fighting equipment. Tuthill stands the test of severe service.

Tuthill makes Leaf Springs in standard and special types. Submit your Springs problems to our engineers.

TUTHILL SPRING COMPANY 760 W. POLK STREET CHICAGO 7, ILL.



Quality Leaf Springs for Sixty Years

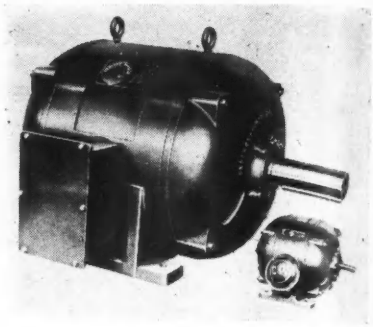
where vibration is present, for it is said to operate indefinitely under conditions where metal ducting would develop fatigue cracks.

It withstands temperatures from 60 F to 300 F without a change in properties and will stand well over 50 psi internal pressure at all temperatures. It is unaffected by air, light, water, gasoline, oil and all mineral acids except concentrated forms. Manufactured in tubes from 1 in. to 6 in. in diameter and in any length desired, as well as in specialized shapes for unusual installations, the ducting can be adapted to any equipment as a replacement or as an original installation.

Airtron is made by Arrowhead Rubber Co., Los Angeles, Cal.

New Crocker-Wheeler Motors

The Crocker-Wheeler Division of Joshua Hendy Iron Wks., Ampere, N. J., has added three new frame sizes to its line of squirrel-cage, protected type, a-c motors. The new additions are designated as B58-A, B and C. Rated 40 C rise, full load continuous duty, with a 15 per cent service factor, the motors in this line provide full protection against dripping liquids, falling metal chips and other foreign matter.



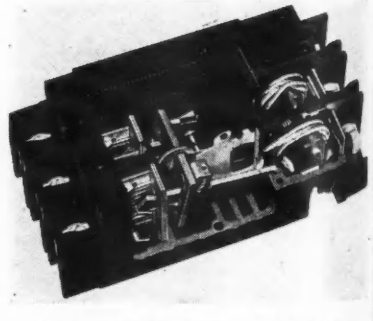
Two extremes of Crocker-Wheeler protected type motors—the B-58 and the smallest of the line, the 203

Sizes built in NEMA standardized frames, 203 to 326, inclusive, have no openings in the frame or shields above the horizontal center line. NEMA standardized frames 326 to 505 as well as the three, newly added, larger sizes are basically the same in construction with the addition of two shielded, air exhaust openings in the upper half of the frame. The design of these openings precludes any possibility of falling liquids, etc., entering the motor.

100-Amp Frame Circuit Breaker

Square D Co., Switch & Panel Division, Detroit, Mich., has just brought out the new ML2 100-amp frame circuit breaker. Ratings are 15 to 100 amp-600 volts, alternating current, 50 to 100 amp-250 volts, alternating or direct current, 2 and 3 pole.

Dust resisting sheet steel enclosures with front-operated handles are available for 3- and 4-wire solid neutral applications in addition to 2- and 3-pole devices. Weatherproof, dust-tight and explosion resisting enclosures also are available for Class I, Group D, and Class II, Group G, hazardous location applications. This breaker is also furnished for panelboards.



Square D ML2 circuit breaker

Pumps for Viscous or Volatile Materials

The Marco Co., Wilmington, Del., is releasing information on a new line of pumps said to handle anything that can be pumped—heavy viscous materials, or light volatile materials with

(*Turn to page 72, please*)

Excellence of Design
Hoover, the Aristocrat of Bearings, are of the Super-Conrad Deep Groove Type employing the largest size and greatest number of balls. This type of bearing, plus the added advantage of Hoover's exclusive honed raceways has been proved, by actual test, to be the most universally dependable for the varying conditions of load and speed under which modern machines operate.
HOOVER
BALL AND BEARING COMPANY, ANN ARBOR, MICHIGAN

Tooling Possibilities of Plaster of Paris

(*Continued from page* 33)

Unlike cast plastic materials these plaster forms have an important property advantage. There is no after or service shrinkage and upon setting, after a pour is made, the shrinkage is negligible.

There are many points in favor of plaster of Paris, as brought out in the preceding paragraphs. Wherein lie its disadvantages? From the standpoint of physical properties, the materials are weak—much lower in strength than the usual organic plastics materials. Furthermore, they have the disadvantage of poor chemical resistance. Immersion in water, for example, leads to their early deterioration. They cannot be operated at temperatures above 120-130F indefinitely as they will lose water of crystallization and grow progressively weaker. Of course, short time exposures to high temperatures do not prove detrimental, particularly if the mass does not heat too rapidly.

Through processes developed by the writer these major disadvantages have been overcome by impregnation of plaster forms with synthetic resins. Impregnated plaster forms have properties which are comparable to those of cast plastics, permitting consideration of their use where cast plastics have been employed. In addition, impregnated plaster forms have advantages of economy in the use of a low cost base; the ease of pouring, setting, and working with plaster; and the negligible shrinkage of these materials even after impregnation and curing of the resin impregnant. There is no reason why every fabricator of plaster forms or articles should not become plastics conscious, as they now have available from the plastics industry materials which will convert their articles to durable and permanent structures. Likewise, those manufacturers engaged in the casting of plastics materials will find the plaster of Paris impregnated forms will bear recognition from the viewpoint of economy and stability of dimensions. Impregnated plaster forms are not suggested as panacea for all casting problems, but they show promise of fulfilling certain applications more efficiently and effectively than cast resins hitherto employed.

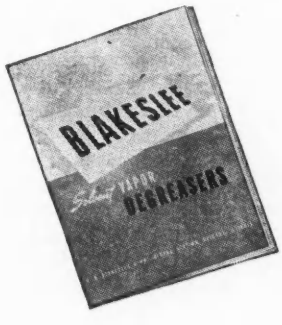
Origin of Plaster of Paris

Plaster of Paris is a specially prepared form of gypsum. Gypsum is a naturally occurring salt, calcium sulphate, which is mined in various deposits throughout the United States. While some very pure deposits exist, it is generally found with various impurities such as limestone, silica or shale. The products of calcination of gypsum rock, which possess the ability to revert back to gypsum when wetted, are called "calcined gypsum" or "plaster of Paris." Their chemical composition in the absence of free water is $CaSO_4.2_2O$, the hemi-hydrate. The material is sold commercially as a finely divided white powder. It is available in various grades such as general purpose casting plaster; a higher strength Hydrocal plaster characterized by negigible expansion on setting; and a high strength casting plaster known as Hydrostone. There are other grades of these materials, but the above classifications are typical.

There are two methods of combining plastics with plaster of Paris: (a) Before the plaster has been poured, and (b) after the form has been set. In the development of the techniques of indurating plaster with plastics materials, the writer investigated combinations of organic plastics with plaster before pouring or casting. Inasmuch as the plaster depends upon water for its setting qualities, it was obvious that a water miscible resin or aqueous emulsion was desirable. In consequence, solutions of water soluble phenolics, urea formaldehyde, and melamine formaldehyde resins were employed. Through the use of these thermosetting synthetic resins it was possible to produce any desirable proportion of organic plastic materials and the calcium hemi-hy-

(*Turn to page* 88, *please*)

Write for free information booklet; your request on your company letterhead will be taken care of promptly.



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IN 1946

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If you wish counsel on preliminary plans for a Layne Well Water System, ask for the cooperation of Layne engineers, which is obtainable without obligation. For illustrated literature, address Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

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Layne Vertical Turbine Pumps are now available in sizes to produce from 40 to 16,000 gallons of water per minute. Their high efficiency saves hundreds of dollars on power cost per year.

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WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

drate. Two techniques were employed: (a) Solutions of the resins were first effected, followed by the addition of plaster; (b) mixtures of the resin in a dry state with the plaster of Paris, followed by the addition of water. The latter technique limited the selection of resins to melamines and urea resin types. In fact, a particularly interesting combination was effected through the addition of approximately equal parts of dry, powdered melamine formaldehyde and dry, powdered plaster of Paris. From all appearances this combination resembled straight plaster of Paris in the dry, mixed state, with the exception that the presence of formaldehyde gave rise to a different odor. The final products yielded hard, light colored attractive articles.

Among other water soluble synthetic resins and cellulose derivatives, combinations were effected with methyl cellulose, polyvinyl alcohol, and sodium carboxymethylcellulose. When solutions were made of these resins only very small proportions could be added, the proportion being usually less than 10 per cent because the viscosity would be much too high for the subsequent addition of the plaster. On the other hand, premixing of these constituents, when dry, made it possible to secure larger concentrations of the plastics with the plaster, though in mixing with water, the technique was aggravated by lumping and non-uniformity of mixes.

In fact, most efforts to precombine plastics with plaster of Paris were confronted with some loss of the easy technique of handling plaster—either by reason of greater problems of mixing accompanied by lumping and formation of gas pockets in the final castings, or because of delay in setting of the plaster and the development of good early strength which characterizes pure plaster of Paris castings. In addition to water miscible resins, it was found possible to include finely divided non-water miscible materials which did not affect setting properties; which, however, detracted from the strength of the final castings. In summary, it may be stated that under certain conditions, attractive and effective combinations of plaster of Paris and plastics may be achieved through premixing with plastics, though in most cases they introduce as many disadvantages as advantages gained. For example, in the case of plaster of Paris and melamine formaldehyde combinations, the gain in tensile strength, flexural strength, surface hardness, and compressive strength was commensurate with the amount of melamine added. The gains were not appreciable until more than 25-30 per cent melamine was present in the final casting. However, the shrinkage also grew in accord with the proportion of melamine added—and quite decidedly—the cost. In analyzing the final end products one may assume that properties equivalent to prevailing cast liquid resins may be achieved. But wherein

(*Turn to page* 90, *please*)

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WITH NEW

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If you are seeking an effective, low-cost way of preventing parts from rusting between machining, grinding, buffing and similar operations, Oakite Special Protective Oil may well be the answer. A recently-developed rust-preventive, Oakite Special Protective Oil has the unusual ability of displacing water and leaving a thin protective coating of oil on iron or steel parts to inhibit rust.

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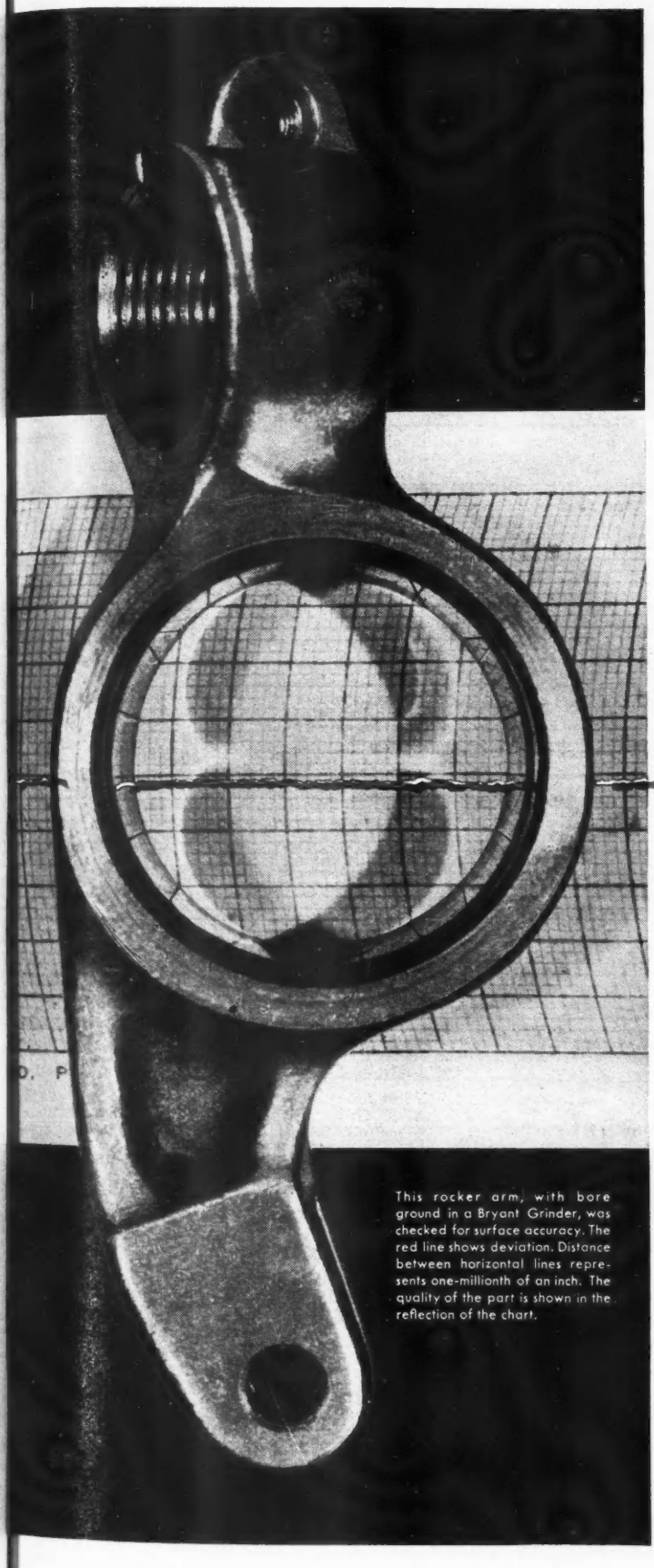

This rocker arm, with bore ground in a Bryant Grinder, was checked for surface accuracy. The red line shows deviation. Distance between horizontal lines represents one-millionth of an inch. The quality of the part is shown in the reflection of the chart.

When you measure *Life* in millionths of an inch

Often times life depends directly on quality of finish and dimensional accuracy. In such cases, it is necessary to precision grind the bore while holding to extremely close tolerances for roundness and parallelism. In every case, rapid production must be obtained. Finding the solution to hundreds of problems like the above has given Bryant a background of engineering know-how, plus a complete line of machines to meet any problems in the internal grinding field.

WE KNOW YOUR PROBLEM IS DIFFERENT

You may never have a problem just like the one illustrated. But the next time you have ANY problem in which extreme accuracy of internal grinding must be coupled with speed of production and the maintenance of close tolerances on other specifications:

Send for the Man from Bryant!

BRYANT CHUCKING GRINDER CO.
SPRINGFIELD, VERMONT, U. S. A.

would be the gain? Costs would be about the same, shrinkage still a problem to contend with, and ease of working with the finished casting no longer available.

Impregnation of Plaster Forms

After conducting a considerable amount of work in combination of plasters with plastics before pouring, it was decided to investigate the impregnation of finished plaster castings with various resins. In the last analysis it would mean that plaster of Paris forms, patterns, contoured blocks, etc., would be made exactly as they have always been prepared. If upon their completion they are treated with the proper resins and cured, they will gain the advantages of the added plastic and still retain the cost, ease of workability, and dimensional stability of the plaster forms. This proved to be the case and after investigating many types of commercial resins, the procedure was established using a low viscosity furfural resin, developed exclusively for the purpose of impregnating plaster.

In an unimpregnated state, plaster of Paris forms may be considered a soft material capable of further fabrication. Design motifs, changing contours, and additional design elements may be included or modified without much additional cost, in a relatively short period of time and at room temperature. In other words, all of the engineering requirements may be reproduced on the plaster form simple and with the assurance of dimensional stability. After this work is completed the furane resins are added to "resinify" the mass and convert the structure to a hard, durable consistency. These resins and their action may be likened to the heat treatment and hardening of steel, except that soft, workable plaster is converted to a hard, durable structure.

In arriving at the selection of a resin for impregnating finished plaster of Paris forms, the mechanism of penetration was carefully studied and the correct material selected for the task. Penetration is possible largely because of fine capillaries which are formed in the plaster of Paris structure upon the evaporation of the free water. There is a limit to the amount of solids which may be added to water to form the pourable plaster mass. There is always left over a certain amount of free water, which is in addition to the water required for crystallization of the calcium hemi-hydrate. Immediately after pouring of the plaster of Paris, the free water separates out and is present in the mass. Two alternatives are apparent: (a) Either use this free water as an avenue of introducing a water soluble plastics material; or (b) remove the water and allow a capillary penetration of the resin. Both alternatives were thoroughly explored and it was found possible to obtain good results with either method, though best properties were obtained by the latter method.

If 100 pounds of pure plaster are added to 60 pounds of water a thick pourable consistency is formed. If less water is used the mixture would be too thick to form a homogeneous dispersion. Approximately 17.5 pounds of the water are required to set the plaster chemically; the balance of 42.5 pounds of water constitutes the free water. When the casting has completely set it will have uniformly dispersed voids in it corresponding to the volume of 42.5 pounds of water—thus determining the maximum amount of resin which may be absorbed for the 100 solids/60 H2O pour ratio. Of course, a higher proportion of water may be employed for pouring—thus forming the much additional free water which must be removed during drying. However, this also means that much additional resin which can be included in the form, and this may be of advantage under certain circumstances. Assuming now that the freshly poured "green" plaster form is to be impregnated, water soluble phenol-formaldehyde and melamine or urea-formaldehyde resins may be considered. With adequate diffusion periods, good penetration may be obtained from these resins. Low viscosity solutions (under 50 centipoises) may be prepared with water and the above-mentioned thermosetting synthetic resins—present to the extent of 50-

(*Turn to page 94, please*)

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SPECIAL COLD DRAWN SHAPES SAVE MACHINING

Improvements in Details Revealed by Chevrolet

Since the announcement of the 1946 Chevrolet line, some supplementary information has been received concerning improvements in details which may be of interest.

For one thing Chevrolet has adopted oil resisting synthetic materials in place of the rubber parts formerly used. Among the new applications are the following: for axle shaft oil seals, transmission rear bearing seal, water pump seal which offers greater resistance to the action of some antifreezes, radiator hose, harmonic balancer grommets, and fan belt.

Although the use of plastics has not increased, one application worthy of comment is found in the Fleetmaster line. This is the so-called "imitation leather" rear seat arm rest cover, now coated with a vinylite plastic having high resistance to deterioration and discoloration.

Some comment already has been made on the corrosion resistance program for the body and sheet metal. The rocker inner and outer panel, the body rear lock pillar lower outer panel, and the rear end panel below the trunk lid are made 30 per cent thicker. Body sill moldings are of solid stainless steel. Bolts now are used for sill molding fastenings at the front fenders and the rocker panel extensions.

The stain finish of chromium plated parts on the instrument panel is produced by the new process of "Vapor-Blasting."

Where the numerous attaching brackets were formerly riveted to the box section structural member of the frame, they are now welded for more rigid attachment.

On Stylemaster models the horn button is redesigned for better locking by the addition of a locking plate under the button. Even when the button is pressed down on the outer edge it cannot get stuck out of position.

The foot dimmer switch has a one-piece die-cast housing, affording better protection for switch parts.

Stemming from war experience, the brake fluid is of better quality and will withstand much lower and much higher temperatures without injury.

Another noteworthy change is the adoption of inverted flared tube and pipe fittings throughout the plumbing system of the car. It is said to be proof against fracture or breakage of plumbing lines under severe operating conditions.

Curtiss-Wright Acquires Marquette Metal Products Co.

Curtiss-Wright Corp. has acquired the Marquette Metal Products Co. of Cleveland, Ohio, manufacturers of precision parts and assemblies for the automotive and aviation industries, G. W. Vaughan, president of Curtiss-Wright, and Herbert Gleitz, president and general manager of Marquette, announced in a joint statement. Mr. Gleitz will continue as president and general manager of the Marquette firm and Mr. Vaughan will assume the newly-created position of chairman of the board.

The Marquette firm is the second company Curtiss-Wright has acquired during the past year, marking a trend for the Corporation in taking over comparatively small manufacturing units where engineering and financial assistance can be used to advantage. Late in 1944, Curtiss-Wright purchased the L. G. S. Spring Clutch Corp. of Indianapolis, manufacturers of spring clutch assemblies for all types of mechanical equipment.

Kaiser-Frazer Cars to Be Unveiled Next January

America's first new postwar cars, the low-priced Kaiser and the medium-priced Frazer, will be unveiled to the public beginning in January in the major cities of the U. S., according to Henry J. Kaiser, chairman of Kaiser-Frazer Corp., and Joseph W. Frazer, president of Kaiser, Frazer and Graham-Paige Motors.

The two new cars will be American-size, six-passenger automobiles with many postwar engineering and design features, Mr. Frazer said.

Simultaneously with the introduction of the automobiles, Graham-Paige will introduce its new line of farm equipment, including a newly engineered general purpose tractor with unique gear and engine features and two models of the Rototiller.

The Kaiser and Frazer automobiles will be powered by two different engines especially designed and developed by Continental Motors in cooperation with Kaiser-Frazer and Graham-Paige engineers.

Both cars will be sold through a nationwide network of approximately 210 distributors and 3,800 dealers, a marketing organization now nearing completion.

The entire Willow Run plant will be used for the manufacture of the products of Graham-Paige and Kaiser-Frazer.

The new tractor will have a four-forward speed transmission with an auxiliary overdrive, making possible eight forward speeds. One of the four forward speeds will be a special low gear designed to permit the use of many implements with take-off applications. The power take-off will be unique in that it will have a "live" power take-off, permitting operation without interruption in starting or stopping.

Two types of engines will be available for the tractor, a newly-developed four-cylinder engine which will burn high octane gasoline and a Diesel which will operate on low grade fuel. The machine will also have two types of wheel units, the tricycle and the four-wheel adjustable front axle type.

Air Forces Order New P-82 Fighter

The first postwar contract let fo the production of a new type airplane said to be the world's first twin fuselage military aircraft, has been awarded t North American Aviation, Inc.

Production of the plane, designate the P-82 Twin Mustang, supplants pro duction of the P-51 Mustang, whic was terminated on V-J Day. The P-8 is also the first combat plane desig and produced from lessons learned i combat by the AAF and is a develop ment of technical engineers at Wrigh Field and the manufacturer.

Following pre-war policy, the initia contract is for a limited number o Twin Mustangs for service testing t be followed by a production order.

Radically designed, the new plan marks a distinct departure from th conventional single fuselage airplane with the Twin Mustang being forme by two fuselages joined by the win and the horizontal stabilizer.

With a pilot in each fuselage an automatic pilot in the main cockpit, i reduces to a minimum the problem o pilot fatigue on very long range mis sions for which the plane was designed

Performance figures show the Twin Mustang has exceptional features i that top speeds in excess of 475 mph are indicated.

Powered by two Packard 12 cy V-1650 Rolls-Royce engines, each gen erating 2,200 hp, the P-82 Twin Mus tang will operate efficiently up to 45,00 ft and will climb above 5,000 fpm. The power plants are equipped with a two speed, two-stage aftercooled super charger on each fuselage, and each en gine has a manifold pressure regulator and water injection system. The plane utilizes two opposite-rotating, full feathering, four-bladed Aeroproducts propellers.

The two fuselages are carried on the center-wing section, which is fitte with a single, slotted-type wing flap and with provisions for machine guns and bomb racks. The outer wing sec tions have removable tips, aileron-type wing flaps and fittings for bomb racks and rocket launchers. Each fuselage has a short rear section actually forming a part of the empennage, which consists of two vertical stabilizers and rudder assemblies linked together by a single horizontal stabilizer and ele vator assembly. Dorsal fins fair the vertical stabilizers to the fuselages to improve directional stability.

Airlines Place Orders

Orders from eight air lines for con version of four-engine C-54 transports amounting to more than $12 million were announced by the Glenn L. Mar tin Co.

The eight lines are Pennsylvania Central Airlines, TWA, Eastern Air Lines, Pan American Airways, Braniff Northeast, Chicago and Southern and Cruzero do Sul, largest air line o Brazil.

Convair Enters General Manufacturing Field

Consolidated Vultee Aircraft Corp., which produced approximately 37,000 combat airplanes during the war, is entering the general manufacturing field while continuing to turn out commercial, personal and military aircraft.

The huge company-owned plant at Nashville, Tenn., will be converted immediately from aircraft production to the manufacture of gas and electric kitchen ranges for The Aviation Corp., parent company of Consolidated Vultee. First models are scheduled to come off the production line in February.

Later, it is expected the Nashville manufacturing center will begin production of farm machinery equipment for New Idea, Inc., control of which was recently purchased by The Aviation Corp.

The manufacture of consumer goods at Nashville means the transfer of production of Stinson Voyager 150 four-place personal airplanes to Convair's Stinson division at Wayne, Mich., which recently completed delivery of more than 4,000 Stinson L-5 "Flying Jeeps" to the Army Air Forces.

Formerly built at Wayne, the Voyager 150 was transferred several months ago to Nashville so that Wayne plant facilities could be used exclusively on military projects.

The Wayne plant now is free to build the Voyager 150, a postwar personal plane capable of cruising at 125 miles an hour over a 500-mile range.

Labor Problems Discussed At NMTA Convention

Labor relations problems dominated all discussions at the 46th annual convention of the National Metal Trades Assn. at Cleveland Nov. 15 and 16. Clinics, panel discussions, and talks covered practically the entire range of labor relations from collective bargaining to unionization of management.

"Shotgun bargaining and collective coercion have replaced true collective bargaining because of a Communistic minority within the ranks of organized labor," Louis Ruthenburg, president of Servel, Inc., told the convention. He characterized the National Labor Relations Act as an un-American legislation because it is heavily weighted in favor of labor, thus denying "all men equality before the law." He called upon an aroused public to call on Congress to revise the Wagner Act to make labor equally responsible for unfair labor practices, and to enact legislation which will rescind all of labor's immunities and special privileges under all laws of the land, not excluding anti-monopoly laws, which apply to business corporations.

George Romney, general manager of the Automobile Mfrs. Assn., drew tremendous applause for his talk on "American Industry at the Crossroads." It is time, he said, for industry to risk making a few bold mistakes rather than to continue timid inaction. Continued progress in America, he said, depends on breaking monopolistic action by unions so that collective bargaining can function effectively between employers and unions individually responsible to workers for the fulfillment of the contract.

Leonard P. Ayres, vice-president of the Cleveland Trust Co., told the group that the theory of purchasing power as a basis for wage increases is entirely fallacious. Increased productivity is the only sound theory on which to raise wages, he said. The government policy of requiring business to operate at a low or no profit works against full employment and does nothing to combat inflation, he charged, because it provides more money in the hands of purchasers and results in fewer goods to buy. The American standard of living is going down, he said, because organized labor has more control over the economic policies of the country than the government itself has. This can be changed only by making unions more responsible to the government, the public, and their own members. Higher wages, higher costs, and higher prices are inevitably coming, he explained.

Parker-Wolverine Co. and Udylite Corp. to Merge

A proposed merger of the Parker-Wolverine Company with the Udylite Corp., both of Detroit, was agreed upon by directors of both corporations and will be submitted at meetings of shareholders of both companies on Feb. 20, 1946.

The Udylite Corp., producers of all types of metal finishing equipment and supplies, operates three Detroit plants. Parker-Wolverine produces finished fabricated parts and renders metal finishing service from five Detroit plants.

The proposed merger provides for issuance of 2½ shares of Udylite stock for each of the 135,931 shares of outstanding Parker-Wolverine stock.

Charles H. Awkerman, chairman of the board; L. K. Lindahl, president; Clyde H. Reeme, vice-president and treasurer, and Horace S. Maynard, secretary, along with Willard M. Cornelius and Luis E. Eckelmann, are the directors of the Udylite Corp. They will continue as officers and directors of the continuing corporation.

Chevrolet to Build West Coast Assembly Plant

The Chevrolet Motor Division of General Motors Corp. has purchased an industrial site of 100 acres in Van Nuys, Cal., and within the near future will begin the construction of an assembly plant.

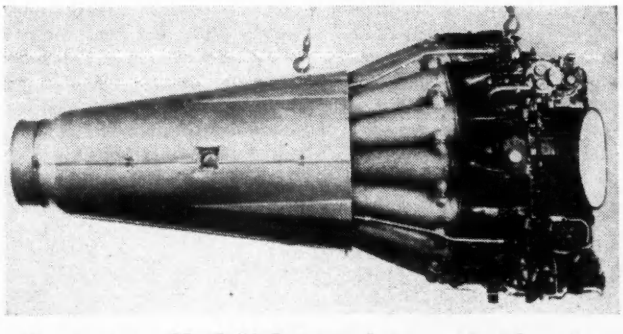
This is the second General Motors operation to be located in the Los Angeles area. In South Gate, the Corporation began operations in 1936 and the plant there recently resumed the production of Chevrolet trucks. By the first of the year, however, the South Gate plant will be turned over to the production of passenger cars in the Buick, Oldsmobile and Pontiac lines.

During the peacetime years preceding Pearl Harbor, the west coast was supplied with Chevrolets built at the Oakland plant, which was erected in 1916. This plant, taken over by the Government during the war years, will shortly be returned to Chevrolet and will be reconverted to its former activity, but it has been decided to supplement its production by that of the Van Nuys plant in order to assure ample supply.

Ford Rebuilding Foundry

The Ford production foundry is to undergo a rehabilitation which will cost approximately $10 million, according to M. L. Bricker, vice-president in charge of manufacturing for Ford. The project includes enlargement of the core rooms and building of a large new core room, rebuilding four systems for production of motor cylinder blocks, installations making possible more efficient handling of hot metal, installation of new dust collector equipment, and the installation of bulk material handling systems.

De Havilland Goblin Turbojet



This power plant, which is now in quantity production, is the standard power unit of the British de Havilland Vampire fighter. It is rated at 3000 lb static thrust at sea level, which gives the plane a maximum speed of 540 mph. This is the sustained level speed of the standard Vampire combat aircraft with full military equipment and armament. Much higher speeds are said to have been attained in current development work. The Goblin is a simple engine with straight-through gas flow and single-side centrifugal compressor. It has already run 500 hours under official type-test conditions without change of any main equipment.

per cent solids. After the resin has been given a chance to diffuse into the "green" plaster, the free water must be removed before the benefits of the resin addition can be realized. This is accomplished either by long time atmospheric drying, or at an elevated controlled high temperature in an oven. The latter must be handled very carefully to avoid removal of moisture of crystallization, or the part may be weakened rather than strengthened. When the water is removed and the resin cured, perhaps by catalysts included in the water mix, the plaster forms will be found to be hardened, and properties improved some 50-100 per cent. However, that represents about the limit, because as will be brought out further in this article, *the gain in properties of the plaster of Paris forms is directly dependent upon the extent to which the voids formed by the free water are filled.* The total resin gain through the water diffusion method will be quite low. It will be found to depend upon how thoroughly the water solution of the resin has replaced the free water, which more often exercises a diluting effect.

Other water soluble thermoplastics can also be considered and they, too, have been tried, with indifferent success inasmuch as their much higher viscosity and molecular weight precluded effective and practical diffusion into the "green" plaster forms. Water soluble silicates and the like have also been considered and tried. At best, a fair build up of the resin at the surface was obtained with the thermoplastic polymers, with an improvement in surface hardness and gloss, but nothing more than what a good sprayed coating could accomplish.

Impregnating Dry Plaster

Diffusion into substantially dry plaster of Paris forms may be accomplished with good results, providing the correct type of resin is employed. The rate of penetration will be found to depend upon many factors, most important of which is resin viscosity and the previous solids/water ratio at the time of pouring. The optimum proportions of solids/water ratios recommended by the manufacturers of these materials are as follows:

Plain casting plaster—100 parts solids to 60 parts water.

"Hydrocal"—low expansion plaster—100 parts solids to 45 parts water.

"Hydrostone"—high strength plaster—100 parts solids to 32 parts water.

The diffusion of a furane resin of 2 to 3 centipoises viscosity into dry plaster of Paris castings is illustrated in Fig. 1. The rapid diffusion of the furane resin should be noted. Straight plaster is best treated with Resin XP, an acid catalyzed resin; while "Hydrocal," which is buffered on the alkaline side, is best impregnated with Resin XR, an alkaline catalyzed furane resin. Overnight, several inches penetration have been obtained into dry plaster of Paris forms, and while greater rates and amounts of penetration can be realized with the aid of vacuum, the entire technique may be accomplished at atmospheric pressure and at room temperature. Of course, the depth of penetration may be readily controlled, as shown in Fig. 2, if only a surface penetration effect is required—though for optimum results, full penetration of the plaster of Paris forms is recommended. The penetration rate is remarkably fast, and results are quite reproducible. From a practical point of view, it is interesting to note that over two years ago some heavy sections at least one foot thick were treated with these resins to obtain full and good penetration. Recently these materials have been made available commercially (Resin XP and Resin XR noted above, from Furane Plastics and Chemicals Co.) and have contributed much to the life and durability of plaster of Paris forms and patterns. Stretch press dies, hydropress form blocks, master mock-ups, foundry patterns, laminating dies, match and contour plates, etc., are a few of the many parts in production from furane resin impregnated plasters.

In a similar manner other low viscosity resins may be diffused into dry plaster of Paris forms, though what counts in the final analysis is, how much solids this resin will contribute

(*Turn to page 96, please*)

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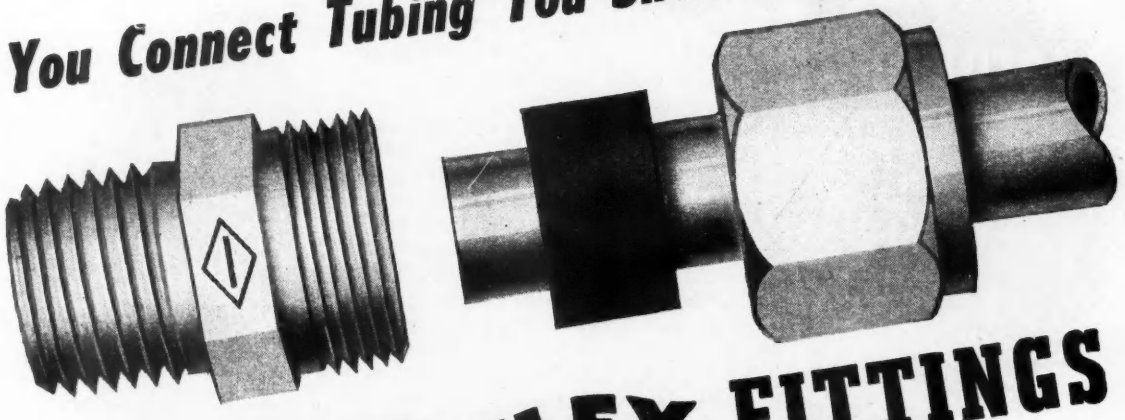

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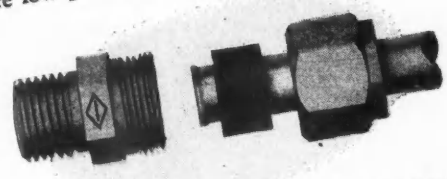
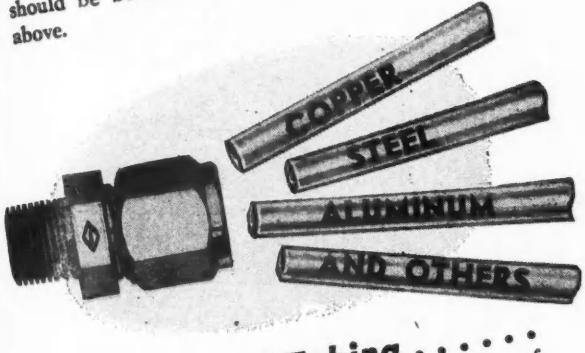
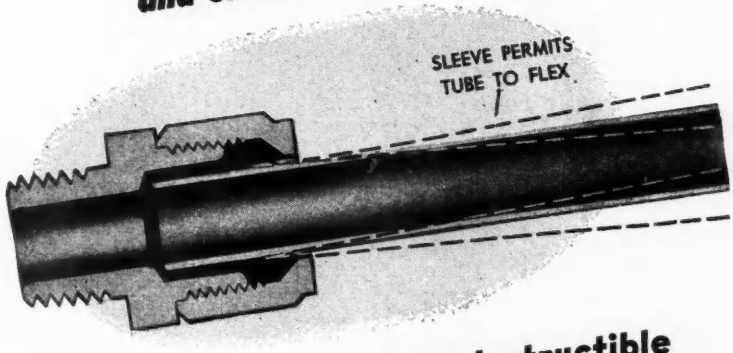


On sizes larger than ½" O.D. and on applications where higher pressures are involved, end of tube should be belled slightly, as shown in illustration above.





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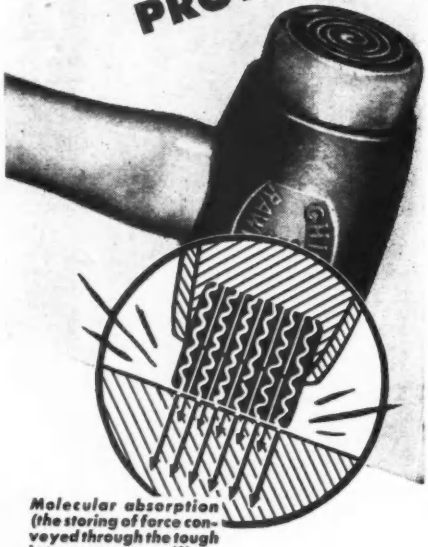

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to the final structure. Emphasis is placed upon low viscosity resins, because if a resin is of too high a molecular weight, it will not diffuse nearly as rapidly as a low molecular weight resin. For example, solutions of polystyrene or polymethyl-methacrylate may be made in appropriate benzene or ethylene dichloride solvents, and the viscosity reduced to a fairly low figure (say, under 100 ops). Upon application to the plaster forms, the solvent portion may diffuse into the structure, contributing nothing to the strength or efficiency of the plaster, while the high molecular weight resin will be filtered out, remaining at the surface. This same effect is also apparent in application of cellulose esters, shellac, asphalts, or other high molecular weight compounds in solution form. Shellac coatings have, for example, been known for a long period of time as sealers for plaster surfaces. They are precisely that—sealers wth little or no beneficial action on the mass of material. In considering the low molecular weight materials or partially polymerized resins, attention may be given to the styrene, vinyl acetate, or methyl methocrylate monomers. The writer has employed these resins for diffusion into plaster followed by polymerization with varying degrees of success. One problem inherent upon the polymerization of this polymer is the fairly high vapor pressure, even at room temperature, and more so during thermal polymerization. Appreciable loss is entailed due to evaporation, though through special means these too may convert the plaster to hard, durable bodies. Another practical consideration which confronts these resins, as well as some of the thermosetting partial polymers, is stability in storage. The plaster pattern, for example, generally requires materials with long storage life. The plaster of Paris, if sealed from moisture, will keep satisfactorily for many months, and if the impregnating resin were to be satisfactory for only a two-month period—as so many of the uninhibited monomers or partial polymers are—dissatisfaction would be apparent among the largest potential consumers for resin impregnated plasters. Liquid furane resins for treating plaster have an indefinite shelf life.

The effect of resin viscosity on the amount of resin absorbed at atmospheric pressure is brought out in Fig. 3. These data were obtained upon furane resins polymerized to different degrees of viscosity, as shown on the chart. The advantages of the lower molecular portions under 100 centipoises viscosity are apparent. Similar results are also encountered for 100 per cent liquid phenolic resins, though these are generally of a very high viscosity (about 1000 centipoises) and incapable of as thorough or as fast a penetration as the furane resins. The latter resins possess excellent wetting properties, and will penetrate into plas-

(*Turn to page 98, please*)

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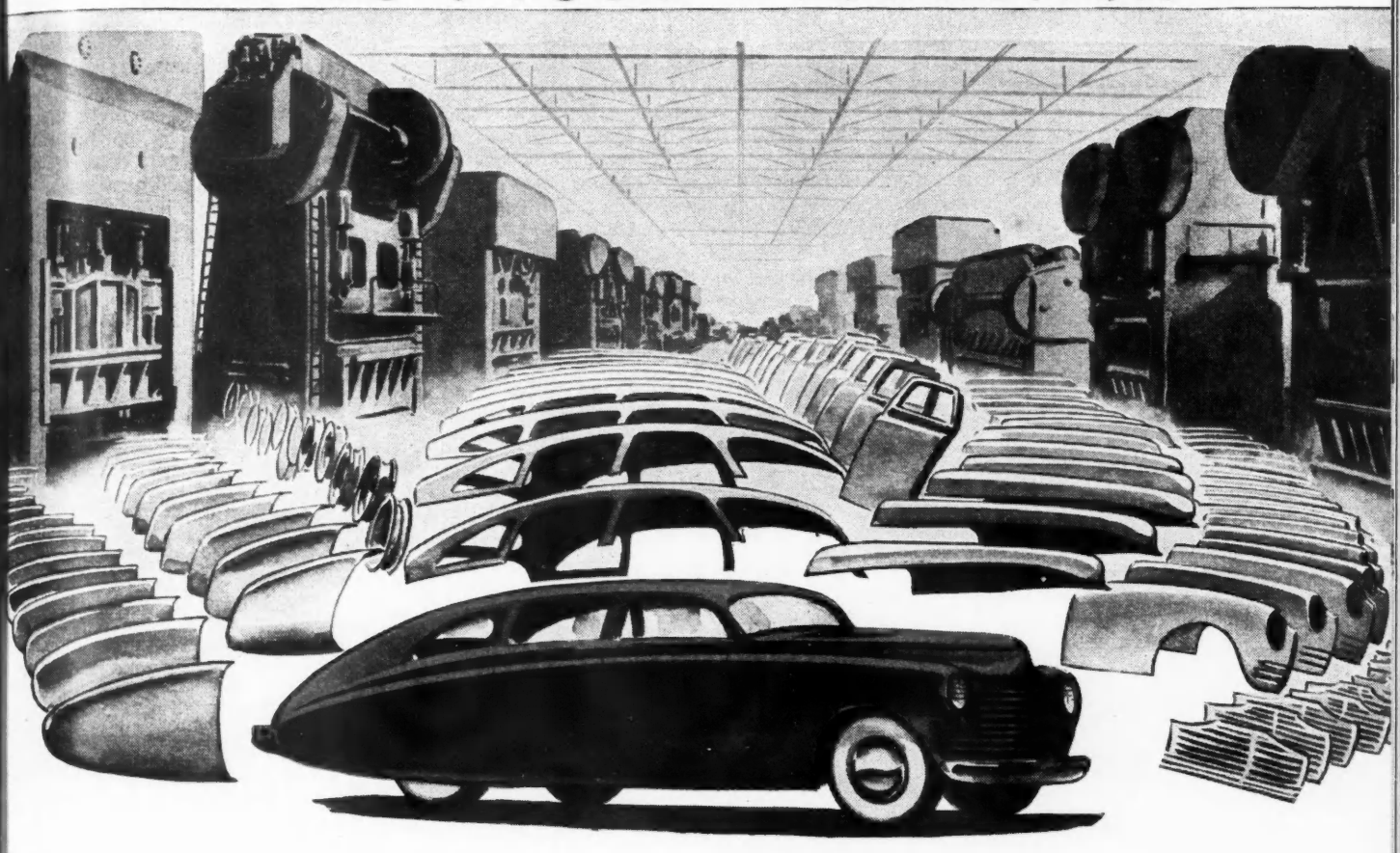

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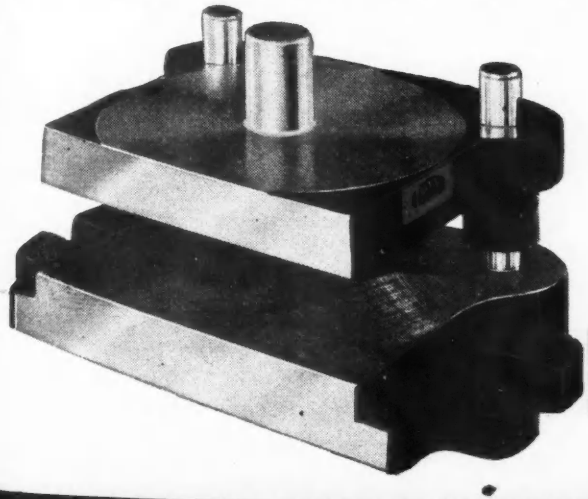

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ter much as water penetrates into a porous blotting paper. Application is very simple, either by immersion or brushing on the final shape.

Among other resins suited for penetration into dry plaster forms or patterns are aqueous phenol formaldehyde, urea formaldehyde, or melamine formaldehyde resin solutions. The phenolics penetrate the best and the melamine solutions the least satisfactorily. The melamines have the advantage of the lightest color, forming a clear surface film which, however, checks appreciably after several weeks. Water soluble phenolic resins can be employed with good results, and after the water has been removed may be effectively cured to develop good strength properties. The combination, however, lacks the superior strength of the furane resin impregnated types and the ability to take higher operating temperatures for appreciable periods of time. From careful examination the answer appears to lie once again in the amount of resin successfully introduced into the voids left by the free water at the time of pouring. Water soluble resins will introduce space filling water solvents, and result in voids which prevent the development of optimum properties. Re-impregnations after drying are not too successful because in most cases there is a higher build-up of resin nearest the surface, and subsequent resin pick-ups are on a much reduced scale.

The furane resins on the other hand are complete liquid resins containing no solvents, and what enters the plaster remains there and is converted to useful properties. While the resins may be cured ultimately at room temperature (over a few weeks' period after activation with catalyst), heat curing is recommended, and a typical cycle of cure is illustrated in Fig. 4. When full impregnation is practiced, the resin impregnated plaster should be heated slowly not only to avoid stresses on large form blocks or tools due to unequal thermal properties, but also to prevent sweating out of the resin on the outside surface. Initial temperatures of 125-140 are recommended, followed by a few hours at 180-190F. Large forms are cooled slowly according to conventional practice for large castings.

Characteristics of Furnace Resin Impregnated Plaster Forms

In Fig. 4 the curing temperature cycle was evaluated by the change in physical properties. In the table (page 32) in this article a comparison is made of the resin impregnated plaster versus the unimpregnated plaster:

Properties have been improved sufficiently to allow plaster shops to take their finished plaster patterns, and without making any further tools, convert these in many cases to a durable structure. These resin impregnated forms are much stronger and are, for example, capable of withstanding hydropress operation and form sheet metal. Without impregnation with resin the forms would crumble and easily break. The savings in tooling costs are tremendous. Not only are there lower material costs in the plaster-furane resin combinations, but also when one considers the time saved in making other patterns for metal or liquid resin tools, the advantages grow. When it is desired to develop maximum impact strength, cotton or glass wool added to the plaster of Paris before pouring and then subsequently cured with furane resin, will give a structure capable of taking much mechanical abuse.

Match plates, contour blocks, drill jigs, lifts from master mock-ups, or the master mock-ups themselves can now be made in plaster of Paris or "Hydrocal" and be recognized as permanent and resistant to the incidental handling which normally causes them to break. While this resin development appeared commercially only shortly before the close of the war, several mock-up sections of leading fighter planes were treated to render them more permanent. The materials and the technique are being widely applied in the reconversion tooling problems.

With reference to temperature, some

(*Turn to page* 102, *please*)

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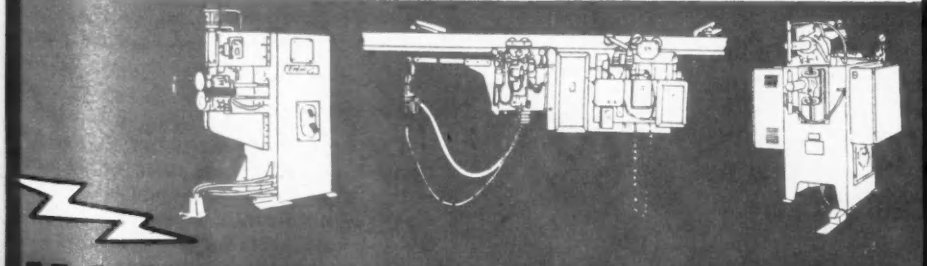

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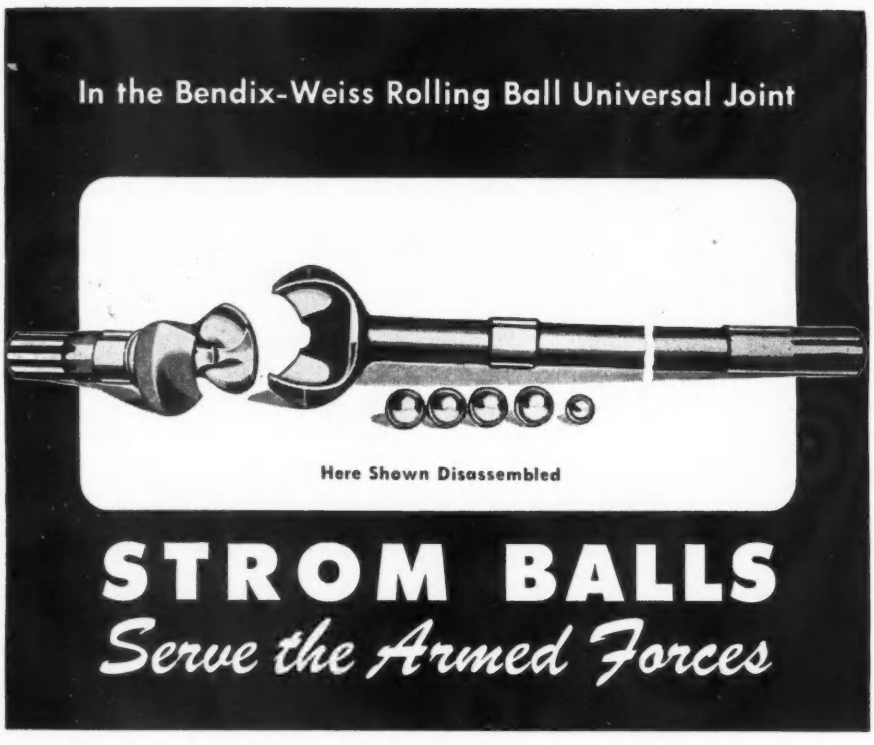
manufacturers have employed furane resin impregnated plaster dies for laminating operations at 250F. These high temperatures do not seriously affect the forms provided if, of course, they are not applied too long. The maximum continuous temperature resistance indicated is in the neighborhood of 180F, or approximately the same range as the prevailing liquid casting resins.

Appearance

The application of furane resins to dry plaster of Paris forms does not result in any build-up on the surface of resin, which is another way of saying that all the resin diffuses to the inside and does not mask any fine surface details. This has been rather important from the standpoint of decorative ceramic work. Plaster of Paris can capture many fine design details which are lost in fired ceramic art work. By resinifying the plaster structure, these details are rendered more permanent and competitive to the ceramic ware. The resinified plaster has the further advantage of obtaining good surface gloss by buffing and polishing, something which is not possible with straight plaster forms. Some pieces look like polished ebony. Stretch press dies find this high surface polish a decided advantage.

Unlike straight plaster of Paris, furane resin impregnated plaster is capable of taking many light surface and decorative finishes without danger of peeling off. Particularly good adhesion of surface coatings is possible upon furane resin impregnated plasters. This is important when decorative and light finishes are required.

It is apparent that resin impregnation adds much to low cost plaster of Paris forms. While there are many ways of effecting these combinations, optimum properties are developed upon dry finished forms. Present indications are that these efforts mark the start of an entirely new phase of the plastics industry in which plastics and ceramics combine their desirable traits to make available new and useful structural and decorative materials.



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Glue in the Automotive Field

(*Continued from page* 25)

had experimented widely with rayon, adopting it for upholstery as well as cover material, floor coverings, and tire cord fabric. Here in America, a number of large auto makers had made use of rayon for specialized purposes. General Motors, after extensive tests, developed an all year round slip cover made of rayon. Dyed in fast colors, this cover had a slippery surface that cut to a minimum friction between clothes and the seat cover. This was in answer to complaints by those wearing fur garments and napped fabrics. Graham also made use of rayon as a lining for storage trunks.

The use of glue solutions for protective coatings and as a dye leveling agent brings closer the goal of car fabrics as outlined by a noted textile authority: long life and ability to take hard wear, maximum style and beauty for luxurious and smart trim effects, ease of handling, elasticity and softness for comfort, ventilation for dissipation of body and interior heat, maximum resistance to spotting and ravages of accumulated road dust and dirt.

Floor Coverings

Thousands of miles of specially treated carpeting are used each year normally by the car industry. The warps of automobile floor coverings are treated with animal glue to impart the necessary wearability to stand up under heavy wear in a concentrated area. Prior to weaving, the "cops," which are the basis of the warp, are impregnated with glue. This provides a tough and durable bond between the lower layer of the rug and the upper layer of cotton and wool known as the "woof." It is easy to see why animal glue is used for a protective coating on floor coverings that go into cars and other places of heavy traffic such as Pullman

(*Turn to page* 105, *please*)

cars and airplanes. Countless feet would literally rip the woof from the warp unless the rug pile was protected by the strongest known adhesive coating for the purpose. Glue compounds are also used on floor coverings to insure greater grease and water repellancy.

This standard of all adhesives, animal glue is also used in large quantities for many other automotive purposes. For example, paints used to finish auto bodies may contain glue as one of their components. Glue-impregnated gaskets made of cork, paper or fiber are used for gas and oil seals in every automobile engine.

Animal glue is the oldest adhesive known; for almost 4000 years, it was the only adhesive used. Made from hides and bones, glue is a protein substance of colloid character. Its ability to alternately jell and liquify makes it valuable for many industrial processes and enables the factory manager to adjust the speed of setting of the glue to the speed of production. Other glue properties of interest to the designer or engineer are: ready miscibility, ease of preparation and application, free flowing consistency, and high joint strength. Glue joints are able to withstand a pressure of between 5000 and 10,000 pounds per square inch placing them second to the metals in this quality.

Though normally low, the water resistance of animal glue can be greatly increased through chemical treatment. Recently concluded experiments by glue manufacturers indicate high water resistance obtainable through the use of small amounts of Formalin as a coating on the glued joint assembly.

Collective Coercion Shot-Gun Bargaining

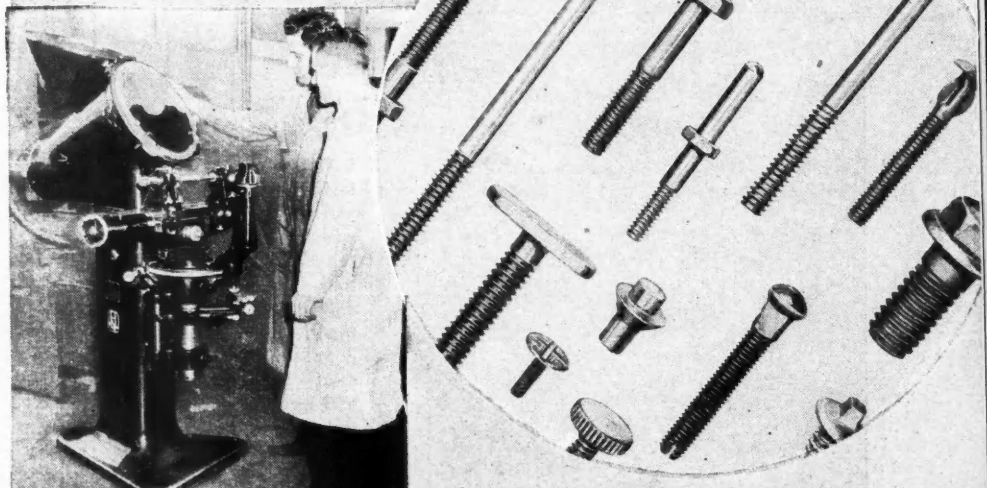
(*Continued from page* 15)

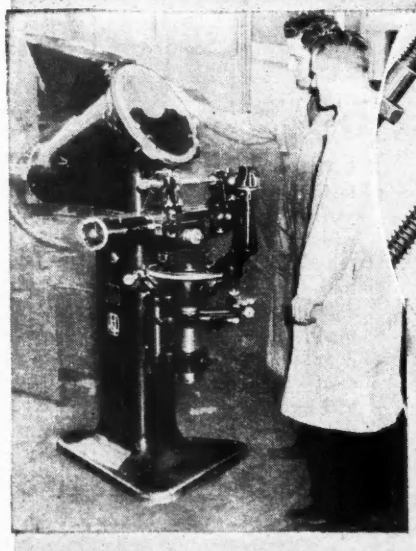
mental basis of orderly government, does not the daily violation of labor contracts follow as the natural effect of an obvious cause? Why wonder at the effective arrogance of the labor lobby? Is it surprising that American workmen have paid millions in tribute for the privilege of working in war plants controlled by organized labor?

American labor has repeatedly and conclusively demonstrated its fine patriotism and adherence to American ideals, but labor is being increasingly victimized by the communists' subtle and effective technique of boring from within. Under such conditions true collective bargaining is impossible. Shotgun bargaining and collective coercion are the order of the day.

Until all men again stand equal before the law no pretty procedures for collective bargaining can have real meaning—no secondary or remedial legislation can have effective force.—

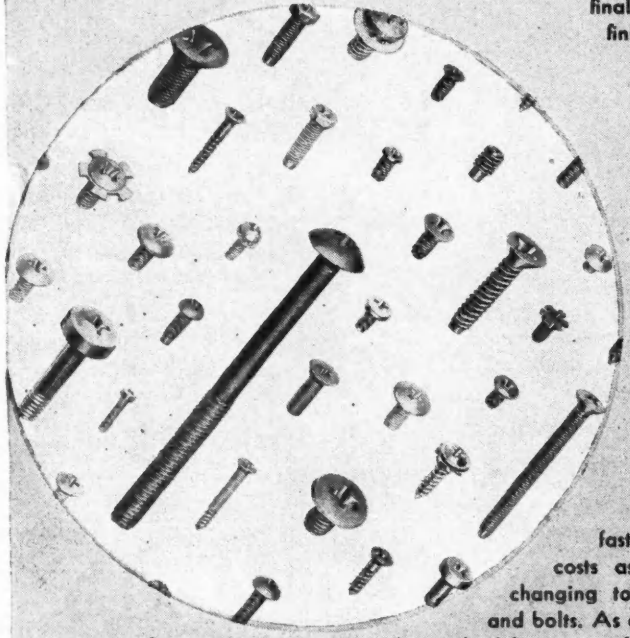
From an address before the National Metal Trades Association.





Modern comparators supplement micrometers, gages and other inspection devices to insure uniform precision of HOLTITE Engineered fastenings throughout production.

"Engineered Fastenings" is not a catch-phrase! It is a brief, obvious designation of the scientific production of HOLTITE screws, bolts and allied fastenings. A technical engineering staff directly supervises every operation, from the analysis of raw material, through our own steel processing mill and wire drawing departments, through each separate stage of manufacture to the final hardening, heat-treating and finishing operations. With modern chemical and metallurgical laboratories and special testing equipment, our engineers have every scientific aid to control the precision production of standard and Special HOLTITE fastenings.



Cut your fastening time and costs as much as 50% by changing to HOLTITE-Phillips screws and bolts. As driver or bit does not slip from tapered recess, power drivers can be used safely, even on finished parts, to speed production and lower costs. Screws set up tighter to resist vibration and strengthen assembly. Specify HOLTITE-Phillips on next order.

BUY MORE WAR BONDS

CONTINENTAL SCREW CO. New Bedford, Mass., U.S.A.

Collective Bargaining—Management Control

(*Continued from page* 17)

with no adequate banks of parts built up and any stoppage among suppliers is felt almost immediately. With steel workers also threatening to walk out and countless strikes and slowdowns among automotive suppliers, the outlook for continued production is anything but good.

Parts manufacturers also are bound to suffer from the General Motors strike according to Frank Rising, general manager of the Automotive and Aviation Parts Manufacturers. He predicted 100,000 men would be out of work within a short time after the strike started and that suppliers who sell 60 per cent of their output to General Motors probably will be forced to close down. Rising also stated that if parts plants go down because of curtailed business with GM, other car companies, including Ford and Chrysler, will be forced to shut down. The union also may close down about 175 tool and die shops working on dies for both current and 1947 models. The strategy would be not to call the men out but to order them to refuse to work on GM jobs. However, since many shops are engaged in work almost exclusively for GM, a large number would be forced to close down.

One point that has generally been missed in public discussions about collective bargaining is that the wage issue is tied up closely with the matter of productivity. This has been brought into negotiations with the union by both Ford and Chrysler. Ford, in a straightforward summation of its case, pointed out that reduced productivity per man has become so alarming that the very future of the company is at stake. The company has demanded that the union bring into negotiations a plan for guarantees against work stoppages and loss of production. Pointing out that there have been 773 work stoppages since the union contract was signed in 1941, Ford spokesmen stated that some provision is necessary to require the union to recognize and fulfill a responsibility of its own in regard to loss of production and to assure the company the same security that it has provided for the union in the contract. Chrysler also has submitted a list of contract revisions designed to assure responsibility of the union for work stoppages. Chrysler suffered 487 strikes during the time the "no-strike" pledge was in effect. Negotiations are in progress at both companies, but there is yet little evidence as to whether the same basis for arriving at wage rates is being followed as is being demanded of General Motors. One Ford spokesman stated that if the union demands access to the books, the company will stand flatly against it.

Although labor trouble is the chief problem of the car manufacturers, the restrictive price ceilings announced by OPA also are adding to their miseries. Henry Ford II, president of Ford Motor Co., stated that the approximately 5 per cent increase allowed his company

(*Turn to page* 108, *please*)

Key parts purchased from General Motors divisions by other passenger car companies:

Company A—Fuel pumps, spark plugs, electrical equipment, ignition parts, wiring, electric motors and shock absorbers.

Company B—Fuel pumps, rubber mountings, ball bearings, plain bearings and shock absorbers.

Company C—Fuel pumps, air cleaners, horns, ignition wiring, ball and roller bearings.

Company D—Engine bearings, shock absorbers, fuel pumps, air cleaners, oil filters, ignition parts, wiring harness, starters and generators.

Company E—Fuel pumps, thermostats and wiring.

Company F—Fuel pumps, air cleaners, mufflers, shock absorbers, ball bearings, floor mats, steering wheels, vibration dampers and motor mounts.

Company G—Fuel pumps, but has other established source to take care of part of requirements.

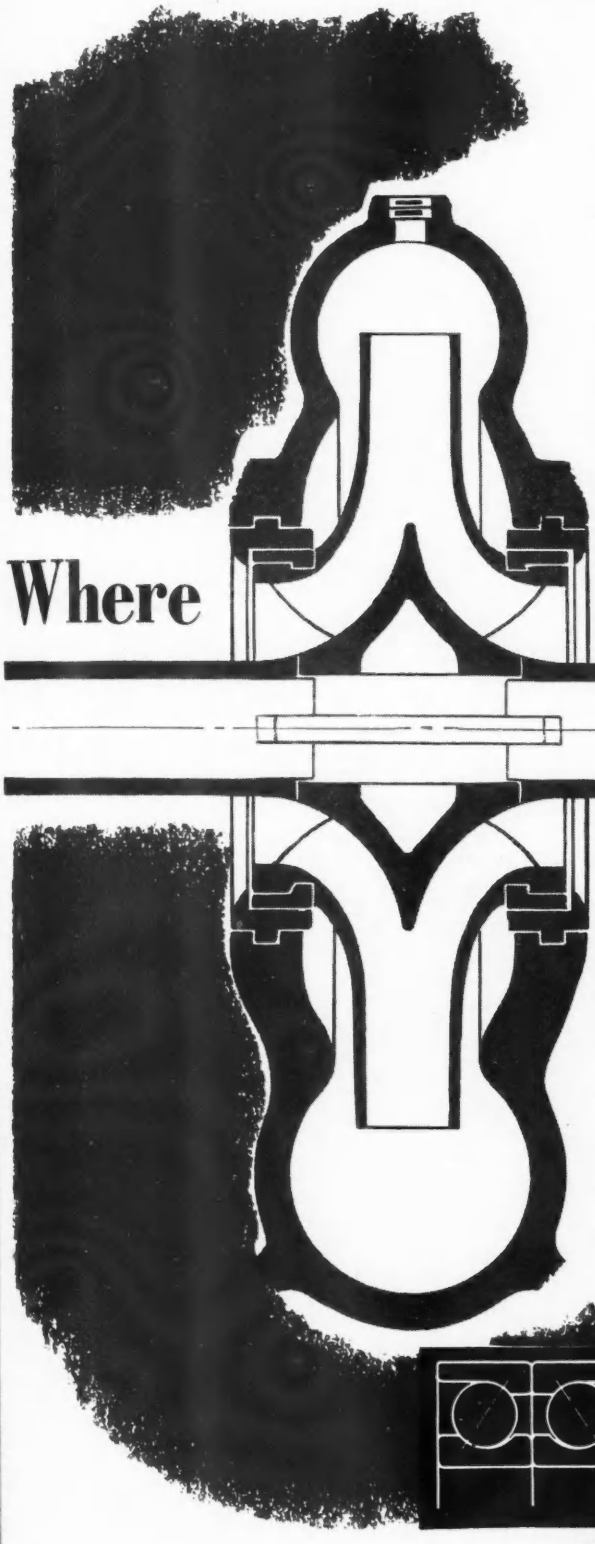
Tooling Up —The utmost in skill and experience is required in laying out a complicated impression on the polished surface of the forging die block. Wyman-Gordon manufactures all its own tools—a greater range and wider variety than any die and tool shop in the industry. Capable men with genuine pride in their craftsmanship—the most modern machine tool equipment—all are responsible for every Wyman-Gordon forging.

WYMAN-GORDON

Forgings of Aluminum, Magnesium, Steel

WORCESTER, MASSACHUSETTS, U. S. A.

HARVEY, ILLINOIS - DETROIT, MICHIGAN

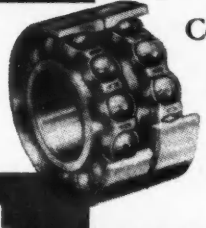


A TIGHT-SPOT with a drive shaft . . . that's a centrifugal pump. It's necessary to fit the rotating element that does the pumping so closely inside the housing that clearances are extremely minute. That's how you get suction and it's also how you can get into trouble if there's end-play in the drive shaft. Only ball bearings can take that combination of heavy radial and thrust load and high speed and hold vital clearances.

Where End-Play is FOUL PLAY

It's Fafnir's job to take on tough jobs like this . . . and come up with a series of bearings such as the Duplex Units. Their greater ball complement and double angularity of load lines enable these bearings to take heavy loads with the ultimate in axial and radial rigidity. They maintain precise clearances between rotary element and casing, require minimum attention and last long beyond anticipated life expectancy.

It's the way Fafnir enters into working partnership with machine designers and machine users in offering practical solutions to any bearing problem that makes so many executives say, "Let's put it up to Fafnir." The Fafnir Bearing Company, New Britain, Connecticut.



FAFNIR BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

does not reflect present economic conditions and that the company will take a loss on its product for an indeterminate period. He did not indicate, however, that Ford will make a protest. Other companies have declined to comment officially but it is understood that they agree substantially with Ford. Most spokesmen say that in view of the stiffly increased costs since 1941, the break-even point will be at a much higher volume than before the war.

Truck Registrations

(*Continued from page* 40)

closely by Ohio with a decrease of 9.28 per cent. In number of units California remains in the lead with 2,719,000 vehicles. New York, in second place, will have around 2,247,000 vehicles registered. Only four states will have registrations under one hundred thousand, Nevada being the lowest with 46,500.

This maintenance of practically similar registrations in 1945 as in 1944 is primarily due to those cars and trucks which came out of storage when gasoline rationing restrictions were lifted shortly after V-J day. While there had been no way in which to actually determine the number of vehicles which were in storage, it was believed by those who had studied the situation that these stored vehicles numbered at least 500,000 units at the beginning of 1945. Their resumption of service has nearly balanced those cars, trucks, buses and taxicabs which were junked, totaling in the vicinity of about 600,000 units.

During the past five years there has been a redistribution of motor vehicles throughout the country occasioned largely by a migration of workers from one section of the country to another and the intensive drive conducted by the used car dealers to purchase cars in the East and ship them to points South and West for resale. While this shift of motor vehicle population was most pronounced during 1942, 1943 and 1944, nevertheless, it had its beginning in 1941 during the early days of production for defense.

Even though it is somewhat difficult to measure this motor vehicle population shift in view of the fact that both state and total U. S. registrations have been steadily declining since 1941, the peak year of registrations, an indication of some of this shift is found in a comparison between the percentage each state total was of the U. S. registrations for the last normal prewar year, 1940, with a similar percentage for each state as of today. (Between these two years, 1940 and 1945, there has been a drop in the number of ve-

(*Turn to page* 110, *please*)

Table I

States which have shown Gains in their portion of Total Registrations in 1945 from 1940.

	1940	1944	1945
California	8.59	8.87	9.13
Michigan	3.80	5.00	4.90
Indiana	3.19	3.17	3.20
North Carolina	1.88	1.97	2.01
Washington	1.79	2.01	2.01
Kansas	1.85	2.00	1.99
Virginia	1.55	1.73	1.80
Georgia	1.61	1.76	1.77
Florida	1.57	1.65	1.76
Connecticut	1.54	1.64	1.62
Maryland	1.42	1.54	1.53
Tennessee	1.34	1.49	1.50
Kentucky	1.44	1.44	1.44
Oregon	1.25	1.37	1.38
Nebraska	1.31	1.34	1.36
Louisiana	1.20	1.33	1.32
Alabama	1.02	1.18	1.18
Colorado	1.12	1.12	1.14
South Carolina	.99	1.09	1.09
Arkansas	.80	.89	.90
Maine	.64	.64	.66
North Dakota	.58	.60	.61
Utah	.45	.51	.51
Arizona	.43	.46	.45
Wyoming	.27	.27	.28
Delaware	.23	.22	.22
Nevada	.14	.16	.16
Massachusetts	2.87	2.76	2.87
Mississippi	.79	.80	.79
Rhode Island	.59	.58	.59

Tenite steering wheel molded by Sheller Mfg. Corp. for 1946 Packard

Foremost plastic of the automotive industry

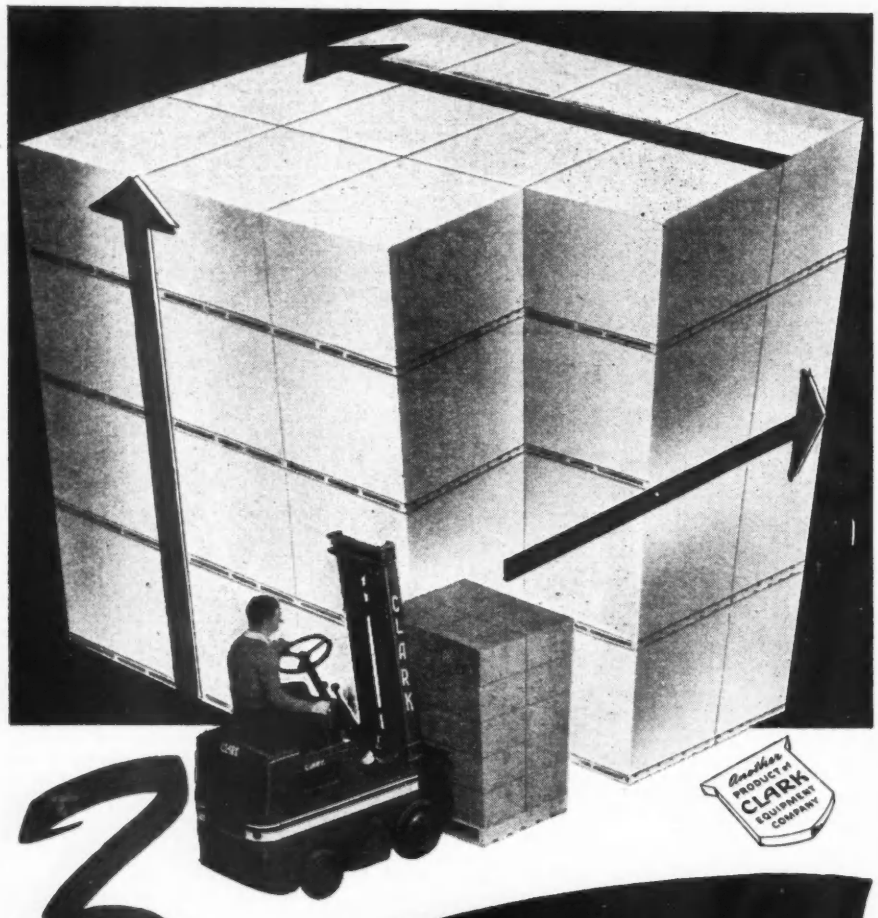
Tenite has steered leading makes of American motor cars for ten years. During the war, it was a natural choice for the steering wheels of landing craft, jeeps, and Army trucks, and control wheels for bombers. Now, Tenite is once again back in civilian life and will shortly make its appearance on the steering wheels of 1946 automobiles.

Motorists will also find Tenite used again for the control knobs, gear-shift levers, handles, and panels of their new cars. Colorful, shatterproof, pleasant to touch in any kind of weather, Tenite has proved ideal for interior appointments of motor cars in every price range.

Tenite is manufactured in a number of formulas which suit it to a wide variety of uses. It is available in unlimited colors — opaque, translucent, and transparent. For more information about Tenite, its properties and many uses, write TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

Tenite

an Eastman plastic



3 DIMENSIONAL USE OF SPACE THROUGH THE TIERING SYSTEM!

CLARK fork trucks utilize all factors in material handling

- ✓ High stacking utilizes "ceiling heights" or "air rights."
- ✓ Speed in handling utilizes time.
- ✓ 24 hour a day performance utilizes round the clock availability.
- ✓ Low cost operation and long life utilize savings on investment.
- ✓ Clark Fork Truck performance utilizes all factors in material handling.

CLARK
TRUCTRACTOR, BATTLE CREEK, MICHIGAN

Products of CLARK • INDUSTRIAL TRUCKS AND TRACTORS • BOOSTER UNITS • EASY ROLL TRAILER AXLES AXLES FOR TRUCKS AND BUSES • GEARS AND FORGINGS • ELECTRIC STEEL CASTINGS • METAL SPOKE WHEELS TRANSMISSIONS • AXLE HOUSINGS • RAILWAY TRUCKS • BLIND RIVETS • HIGH-SPEED DRILLS AND REAMERS

hicles registered of slightly over two million, or about 6.52 per cent, but the decline since the peak year, 1941, has been approximately 4,300,000 vehicles, or about 12.6 per cent.)

In Table I there will be found listed those states which have increased their portion of the U. S. registrations in 1945 as compared with 1940 and to show the change of this year over last we have also added the data for 1944. Table II lists those states which have a smaller portion of the U. S. regis-

Table II

States which have shown losses in their portion of Total Registrations in 1945 from 1940.

	1940	1944	1945
New York	8.63	7.44	7.53
Pennsylvania	6.76	6.44	6.50
Illinois	6.16	5.80	5.73
Ohio	6.15	6.16	5.61
Texas	5.38	5.19	5.13
New Jersey	3.42	3.31	3.32
Missouri	2.93	2.79	2.79
Wisconsin	2.86	2.77	2.74
Minnesota	2.77	2.53	2.49
Iowa	2.51	2.32	2.30
Oklahoma	1.82	1.66	1.67
West Virginia	.94	.92	.91
South Dakota	.62	.60	.60
Montana	.61	.53	.52
Idaho	.52	.49	.50
New Hampshire	.41	.39	.40
New Mexico	.40	.37	.39
Dist. of Columbia	.57	.42	.38
Vermont	.30	.28	.29

trations. In both tables the states have been listed according to the descending order of their per cent of total registrations in 1945.

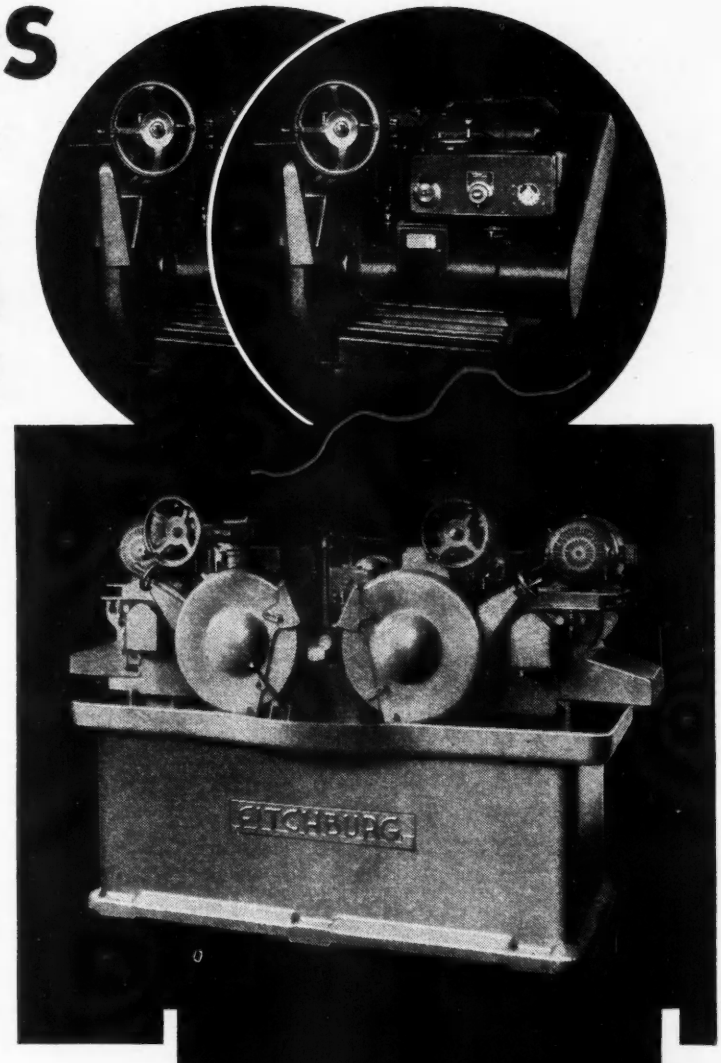
It must be borne in mind that there is no real comparison between the data shown for 1940, 1944 and 1945, as the percentages for each year are based on a declining total. These calculations will illustrate, though, that California, which in 1940 had 8.59 per cent of all registrations, today has 9.12 per cent, but at the same time the number of all registrations has dropped over 2,000,000.

However, the results of the calculations shown in Tables I and 11 should be of interest to all manufacturers of replacement parts, accessories and service equipment, and it is for their benefit that this analysis has been made.

Donaldson Opens Three New Field Offices

The Donaldson Co., St. Paul, Minn., manufacturer of air-cleaning equipment, has opened three new field offices. The new Cleveland office, under the management of Mr. G. C. Bohn, is located at 2114 Lamberton Road, Cleveland Heights. The Chicago office, at 600 S. Michigan Ave., is managed by Mr. C. D. Walter. The Detroit office, at 6432 Cass, will be managed by Mr. F. H. Funke.

TWO HEADS ARE BETTER THAN ONE IN MULTIPLE PRECISION GRINDING



When Fitchburg engineers put their heads to the "grindstone" to develop a method that would cut costs on precision grinding as multiple tooling has on machined work, they emerged with a revolutionary idea. This new design not only makes other equipment obsolete — it also prevents its own obsolescence by its unique engineering feature!

The basis of this Fitchburg method is an independent standard interchangeable grinding head which may be mounted singly or in multiples on standard or special equipment, and may be regrouped and remounted on standard machines or on new special bases, for operations other than the one originally specified. Mounted singly, it can perform more jobs than was thought previously possible — straight or bevel gears, internal or external gears, etc. — due to its independent positioning and its ability to be set at any angle the work requires. Mounted in multiples, its production uses are even greater.

THE HEAD. *The Bowgage Head* is a completely independent precision grinding unit. It has rapid traverse, slow grinding feed, grinding dwell or spark out, and rapid return to starting position — all started by one push button. It is precise to .0002", minimizing spoilage. It can be removed and remounted for other work, if operations are changed.

THE BODY. *This Fitchburg Double-Head Grinder and Polisher for Gear Shift Grooves* is typical of many special Fitchburg machines into which independent Fitchburg heads can be built to cut costs through multiple automatic grinding on mass production. One grinding wheel rapidly traverses into the slot and then an automatic side wheel motion grinds one side of the slot, then the other. Meanwhile, the other grinding wheel comes in and finish-polishes the first side ground, then the second side which has just been ground. This is an automatic cycle from start to finish.

Write Today for Catalog—Sent Free Upon Request

FITCHBURG GRINDING MACHINE CORP.
FITCHBURG, MASSACHUSETTS, U. S. A.
Manufacturers of—Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Bath Full Universal Grinders and Special Purpose Grinders.

Never before were Timing Mechanisms so important!

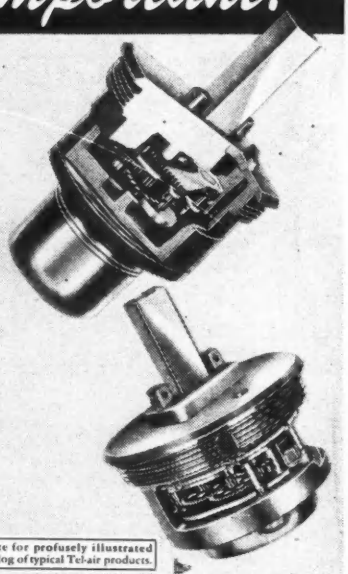
Sel-air

MEANS TODAY'S HIGHEST STANDARDS OF ACCURACY!

Tel-air's manufacture of timing mechanisms is exceptional. Tel-air production of bomb fuzes (tiny timing mechanisms) is a story in itself. Preference of Tel-air by America's leading manufacturers for *today's* expanding market is another. Tel-air parts and assemblies are found precise and reliable by today's standards for long and severe service. Investigate! Resourceful engineering, tooling, and production are fine arts here.

Whatever your problems in timing, bring them to Tel-air for *immediate* attention. PROMPT DELIVERY on all orders, large or small.

Write for profusely illustrated Catalog of typical Tel-air products.



Write for profusely illustrated Catalog of typical Tel-air products.

On the Highway it's Seleoptic T.M. REG. In the Air it's Sel-air T.M. REG.

THE TELEOPTIC CO.

1257 MOUND AVENUE RACINE, WISCONSIN

speed up sheet handling with Safety for Men and Materials

C-F SHEET LIFTERS

. . . carry more sheets per load—faster and safer with no danger of dropped loads. Stack sheet stock—loose or bundled—higher, evener, closer together.

Features insure maximum protection for both men and materials. Long carrying angles prevent damage to edges. Surface scratching of high grade stock is prevented.

One-man end operation or remote cab control keeps workmen away from danger point, plus eliminating need for extra aisle space. Cuts labor cost—no sling crews necessary—accident hazard minimized.

Sliding lock bar (optional equipment) quickly adjusts legs to accommodate different widths. Tong action compensates for sag.

C-F Lifters are available in capacities from 2 to 60 tons or larger, in standard or semi-special designs to meet your specific requirements. Write for bulletin SL-21.

CULLEN-FRIESTEDT CO.

1389 S. Kilbourn Ave., Chicago 23, Ill.

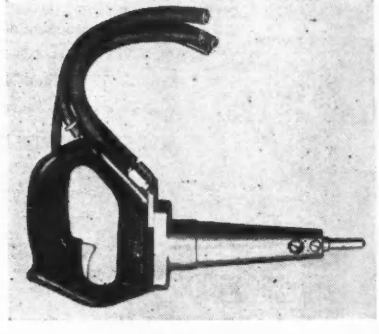
New Products for Aircraft

(*Continued from page* 46)

Army-Navy Specifications AN-W-C-591b, dated March, 1945. The pressurized receptacle is subjected to a pressure differential equivalent to 30 psi for a period of one hour at a constant temperature, and must likewise be tested under water. In the thermocycle tests at the same maximum of 30 psi, several cycles of temperature are given, ranging from —67 F to 185 F.

Riveting Iron for Explosive Rivets

This explosive rivet iron for setting du Pont explosive rivets which are widely used in blind applications and hard-to-reach places is made by the Ripley Co., Torrington, Conn. The Ripley Co. has acquired all Goodyear rights to the low voltage riveting iron



Riveting Iron

and has completed arrangements with the Explosives Department of E. I. du Pont de Nemours & Co., Inc., to produce the du Pont No. 6 riveting iron. It will be sold by du Pont for production applications.

North American Aviation Plant Leased by GM

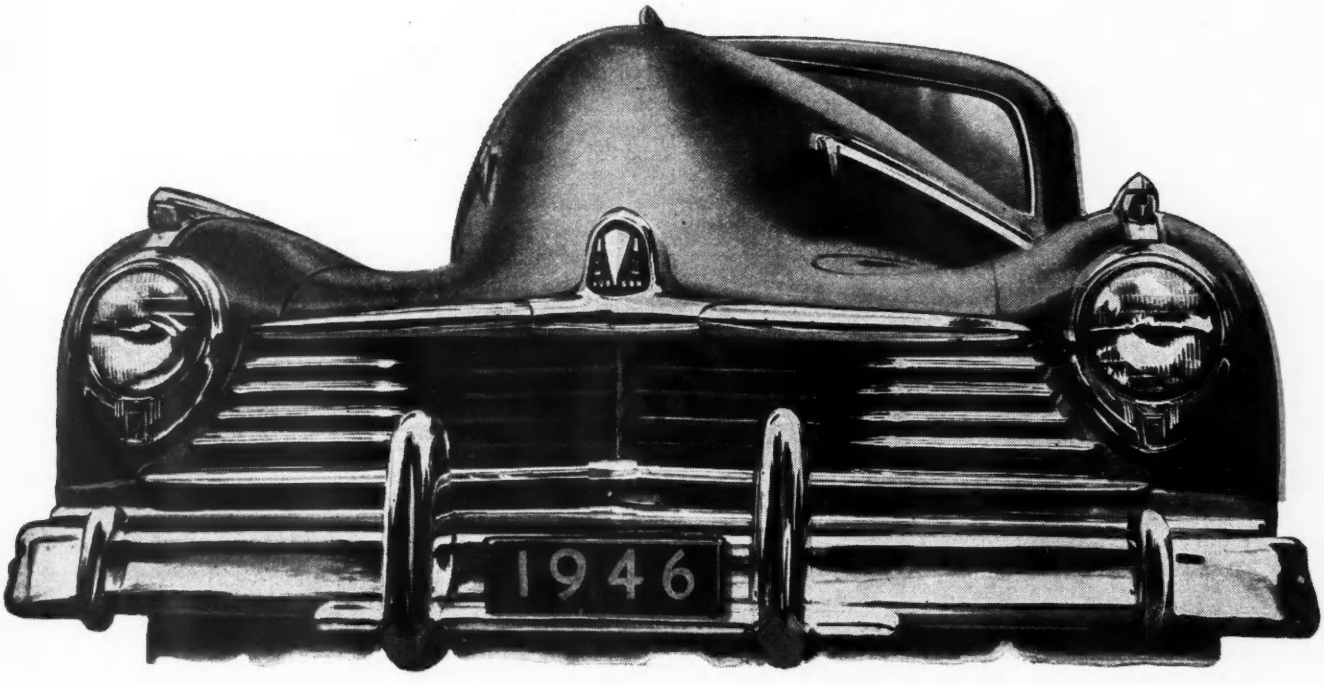
General Motors Corp. has leased the entire North American Aviation plant at Kansas City, Kan. According to the terms of the lease, the plant, which will be used for the assembling of Buick, Oldsmobile and Pontiac cars, will be taken over by General Motors at an early date.

Major changes in the plant will be started immediately after occupancy, labor conditions permitting.

Actual production of cars is scheduled to begin in March with the first car coming off the end of the assembly line some time in April. This plant, which will be one of six similar Buick-Oldsmobile-Pontiac assembly plants spread across the country, is expected to reach capacity production by the middle of 1946.

R. J. Wilkins, who has been carrying on negotiations for the properties in both Kansas City and Washington, will be the manager.

The 1946 HUDSON

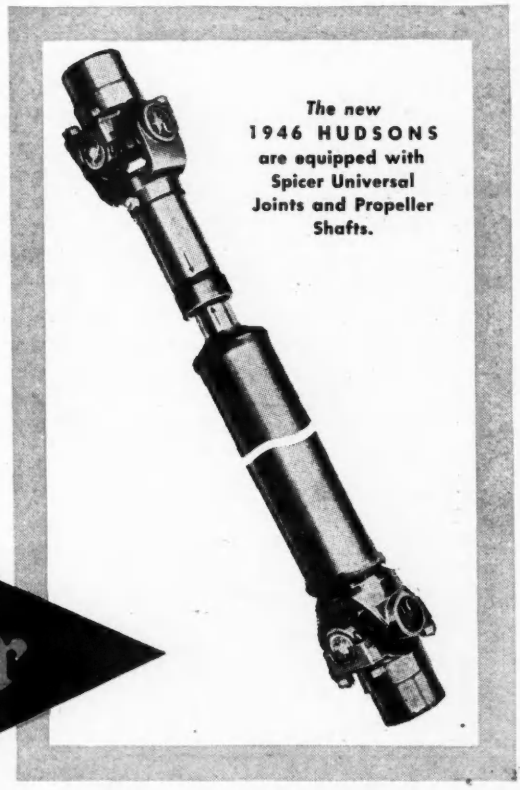


Spicer Equipped as always!

Spicer universal joints have been standard equipment on Hudson motor cars since they first were built in 1909. This 37 year record of dependable Spicer service will continue in the sleek new 1946 Hudson automobiles now leaving the assembly lines. And each new Hudson on the road will add greater prestige to Spicer engineering and manufacturing skill . . . for 42 years the standard of excellence in the automotive power transmission field.

Spicer Manufacturing Corporation, Toledo 1, Ohio

42 YEARS OF **Spicer** SERVICE



Schwitzer-Cummins Equipment

(*Continued from page* 31)

maintained in close axial alignment, held to within 0.002 in. indicator reading.

Our readers doubtless are familiar with the problems involved in machining castings which must be oil-tight or water-tight at assembly. Frequently, evidence of porosity does not develop until the casting has been completely finished in the machine shop. To avoid such costly rejections, in keeping with economic cost levels, all oil pump and water pump castings are cleaned and water tested before they are delivered to the machine shops. After passing the water test the castings are sprayed with a sealer which serves the dual purpose of a sealer and rust preventive.

Owing to the multiplicity of parts produced in this plant, the foregoing examples of production routings are offered as being typical of the operations and quality standards on similar parts. The pictorial section will provide the reader with a selection of views in various departments for a better visualization of the plant and its equipment.

ANNOUNCEMENT!

Here is a Complete Drop Forging Service for Your Peace-Time Manufacturing!

Its own war-time manufacturing needs dictated that Aircraft Mechanics, Inc., of Colorado Springs organize and equip its own drop forge plant—complete as to die-sinking and engineering, mechanical and magnaflux inspection, sandblasting or finish machining.

Several hundred essential manufacturers have used our forging facility throughout the war period—providing an "on the job" testing of our ability to produce as scheduled.

Now, with many war goods contracts reduced, some of our facilities are available for civilian as well as war essential forging needs.

Our drop hammer equipment for forge purposes includes six hammers ranging from a 600 pound drop to a steam hammer of 4,000 pounds capacity. It also includes such accessory equipment as trimmers, heat treat furnaces, standard and automatic sandblasting machines, and special quenching, cooling and pickling facilities.

We have produced forgings weighing up to 25 pounds and more, and as small as one ounce in weight.

And, in addition to our forge development, Aircraft Mechanics, Inc., has produced many thousands of welded tubular and machined parts for more than 50 major manufacturers participating in the war production program. A portion of these facilities also are now available to manufacturers.

If you wish full information regarding our ability to serve you, too, write us . . . today!

★ AIRCRAFT MECHANICS INC.

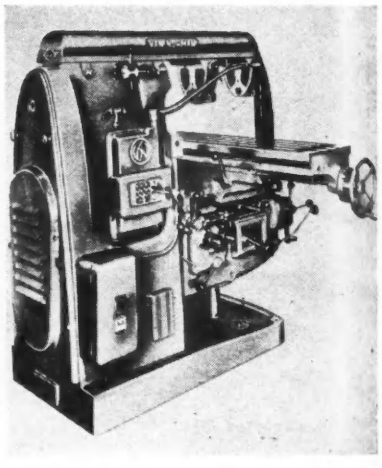
COLORADO SPRINGS, COLORADO

DESIGNERS ★★★ ENGINEERS ★★★ MANUFACTURERS

New Production Equipment

(*Continued from page* 44)

dove-tail ways bearing on the column. Improved cam-type gibbing solidly locks ram to column front and rear. An overarm pilot wheel provides ease for positioning the overarm. Sturdy arbor supports, for B style arbors, are clamped to the underside of the overarm by cam-type locks. These supports are equipped with oil reservoirs which simplify arbor lubrication.



Van Norman milling machine

The new heavy duty cutter spindle and transmission incorporates wide face hardened alloy steel gears mounted on multi-splined shafts rotating on taper roller bearings.

Warehousing Service For Nitralloy Steel

Joseph T. Reyerson & Son, Inc., recently inaugurated a distinct innovation in warehousing service—the warehousing of Nitralloy steels in a variety of sizes, in locations convenient to users in the automotive industry.

While Nitralloy has been known and used for many years, its output and uses were increased tremendously during the war under the spur of aircraft needs. For example, aircraft engine cylinder barrels and many other parts, including gears, were made of Nitralloy. According to its producers there is considerable interest today in Nitralloy for cylinder liners. In heavy duty engines, particularly, where long life is demanded, many applications appear in the offing for parts such as gears, shafts, bushings, etc., where extreme wear resistance is important.